



C4 Information Directorate

AIR FORCE RESEARCH LABORATORY

Annual Review with an Economic Impact Analysis

FISCAL YEAR 2014

Air Force Research Laboratory
Information Directorate
Rome, New York



Message from the Director

This past year has been epic! The Information Directorate's customer base has grown significantly and for the first time in history we received over \$1 billion to respond to the research needs of the Department of Defense (DoD). The increased portfolio is evidence of our value to the nation. Our customers have many options; however, they choose to come to Rome for their most pressing research and development (R&D) challenges in the areas of Command and Control, Communications and Networking, Computational Science, Intelligence Exploitation, and Cyber Security Science and Technology.

We are gaining national prominence in Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber. In 2014, we showcased our technical areas of expertise, talented teams, and unique operational and state-of-the-art research facilities to over 40 distinguished visitors! Of the many Air Force visitors, we are proud to report exchanges with the Secretary of the Air Force, the Undersecretary of the Air Force, and the Chief Scientist of the Air Force. Other key visits included many Air Force command partners, political leaders, industry collaborators, international experts, and academic colleagues. We take pride in building a team that is essential for responding to the needs of the Air Force and the Nation.

[We are making a difference in today's challenging world.](#)

As proponents of innovation, we developed opportunities, business models, and commercialization pathways for new ventures based on the Air Force Research Laboratory's (AFRL)¹ intellectual property. We started the first Commercialization Academy designed to move technologies from the laboratory to the commercial marketplace. This is a first in AFRL! We re-energized our science and technology (S&T) inventors by matching them with developing entrepreneurial leaders to explore the possibility of spin-off technologies that may result in new companies. This fosters the growth of the local technology and entrepreneurial ecosystem that in turn creates economic growth for central New York and the Nation.

In 2014, our Technology Transfer (T2) efforts achieved the national award from the Federal Laboratory Consortium (FLC) for outstanding work in support of Science, Technology, Engineering, and Mathematics (STEM) and the Northeast Regional Laboratory Award in recognition of extraordinary efforts in T2 activities. There are over 300 laboratories in the FLC so receiving these awards is a significant national recognition.

We continue to lead AFRL in Educational Partnership Agreements (EPAs) with over 150 universities and Cooperative Research and Development Agreements (CRADAs) with more than 70 firms. Collaboration with the best and the brightest is our mantra. We recognize the power of sharing and are deeply committed to partnering with academia and industry to help provide cyber and information technology solutions to our nation's most pressing problems.

¹ The Information Directorate is one of 9 Technology Directorates under the headquarters organization Air Force Research Laboratory (AFRL) based at Wright-Patterson Air Force Base, OH.

During 2014, we invested in our workforce. New skill sets were gained through courses and certifications brought to the Lab. We continue to pursue agile software development through our Scrum Masters and Project Management Professional (PMP) certifications and have sponsored training from industry luminaries in innovation. The Lab continues to sponsor advanced education at the Master and Doctorate levels and is committed to sending our workforce to the best graduate schools in the world.

Providing value for our growing customer base, developing innovative products, and investing in our people has made 2014 an epic year for Rome.

Plans for 2015 include growing our talented team and increasing recruitment efforts. Today's workforce is as fluid as any in history, especially in the high demand information domain. To attract and retain talent, we need to communicate our sense of mission. To work for a defense or federal lab means that you are solving problems of national importance and your contributions are protecting this great country. That sense of mission and patriotism drives our workforce. We look for that sense of duty and desire in whom we recruit.

Our technology area is not only rapidly changing but also accelerating. If we are to deliver value to our customers, we need to be fast and agile. The exponential doubling of change in information technologies makes it more rapid than ever before. Everything we do is focused on helping someone or something make a decision. Lewis Carroll's character Red Queen in *Through the Looking-Glass* could very easily have said, "Competitive advantage is fleeting and we need to run as fast as we can just to survive" – we are running with our customers. We also need to be close to our customers, and at a visceral level, understand the capability they need in order to win. Successful products will be co-developed with our users. Speed to decision – the right decision – will become our competitive advantage.

We are more dependent on information than at any point in history, but this dependence is fragile. Ne'er-do-wells, criminals, and nation states seek to disrupt, steal, or harm us with the same technologies we depend on. Cyberspace is cruel, brutish, and of red tooth and claw. We must continue to increase the entropy of our information systems from the adversary's point of view and improve our software design and development to incorporate better security. Most importantly, we need to secure and assure the military mission that is built upon our information and communications technologies.

As I said in last year's Annual Review, data is the new oil. We are finding more clever ways to extract value from enormous amounts of data. These gushers of data will continue to grow with the burgeoning Internet of Things or as some have now termed, the Internet of Everything. It is estimated that there will be over 50 billion devices connected to the Internet in the next five years.

R&D is NOT a variable cost and time is NOT recoverable. Therefore, we must remain agile and adapt to the oscillations of the budget and DoD direction to remain true to our research agenda of pushing the envelope of information technology and the development of relevant products. The technologies that we develop as a national leader in the C4I and Cyber mission space permeate all that the Air Force, the DoD, and the Nation does. We are making and will continue to make a difference.



**Air Force Research Laboratory
Information Directorate
Rome, NY**

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C4 Information Directorate
Rome, New York



Mission: To explore, prototype and demonstrate high-impact, game changing technologies that enable the Air Force and Nation to maintain its superior technical advantage.

Vision: To lead the Air Force and Nation in Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber science, technology, research and development.



Information Directorate

Why:

Information technologies touch every Air Force, Department of Defense (DoD), and National mission. The success of the mission relies on the quality and trustworthiness of the information technologies and the information that they process. The talented people of the Air Force Research Laboratory Information Directorate (AFRL/RI) are dedicated to making a difference to the warfighter and the nation through research excellence and a close relationship with the customer. AFRL/RI solutions transform and communicate information to commanders and decision makers, enabling them to direct their forces in Air, Space and Cyberspace to achieve mission success.

How:

The Information Directorate researches and develops Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber technologies to ensure the effective and unparalleled ability to process raw data and intelligence into actionable information. AFRL/RI accomplishes the mission through a blend of state of the art research facilities, world class researchers, and strategic collaborations. A unique customer understanding is achieved by having AFRL/RI engineers embedded with its customers at their locations. This not only provides the researchers with first-hand experience with the customer's problems and needs, but also with valuable insights into larger issues, current and future, that the customer may not even know. The Information Directorate's cadre of researchers work with the customer to solve near-term problems jointly and strategically, as well as to address long term issues before they ever become problems. Year after year, customers bring their business because of the Information Directorate's deep understanding of the state of the art and the state of the possible, coupled with current and future needs. AFRL/RI brings together in a single location top Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber researchers from around the country and the world to research, design, develop, prototype, test and evaluate solutions for the Air Force's and the Nation's pressing needs.

What:

The Information Directorate's research and development success is evident through over 100 technologies transitioned to the warfighter within the last two years and over 35 patents granted or filed over the same time period. AFRL/RI expands its own knowledge base as well as that of the civilian sector through partnerships with academia and industry and grows future leaders in Science, Technology, Engineering, and Math (STEM) by partnering with educational institutions to develop challenge competitions, summer camps, mentoring, internships, and workshops. The Information Directorate addresses national security needs both through the technologies transitioned today and the leaders being developed for tomorrow.



Information Directorate Senior Leadership

Back row: Lt Col Frank Yoon, Dr. Kamal Jabbour, Dr. Michael Hayduk, Dr. Paul Antonik, Mr. Joseph Camera **Front row:** Ms. Linda Reed

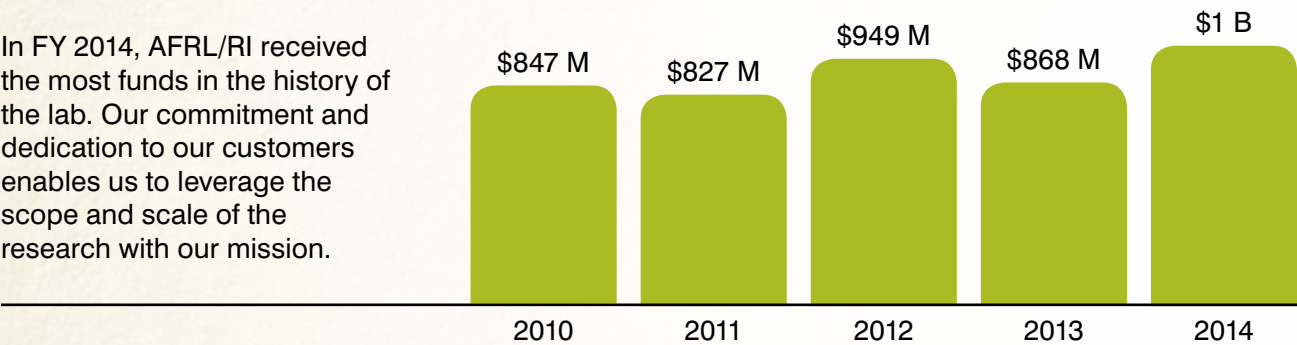


Back row: Ms. Jean Iselo, Col Andrew Green, Mr. Brent Holmes, Mr. Daniel Bollana, Col David Blanks, Dr. Warren Debany, Ms. Margot Ashcroft **Front row:** Dr. Richard Linderman, Mr. George Duchak, Ms. Julie Brichacek

See page 80 for AFRL/RI Organization Chart

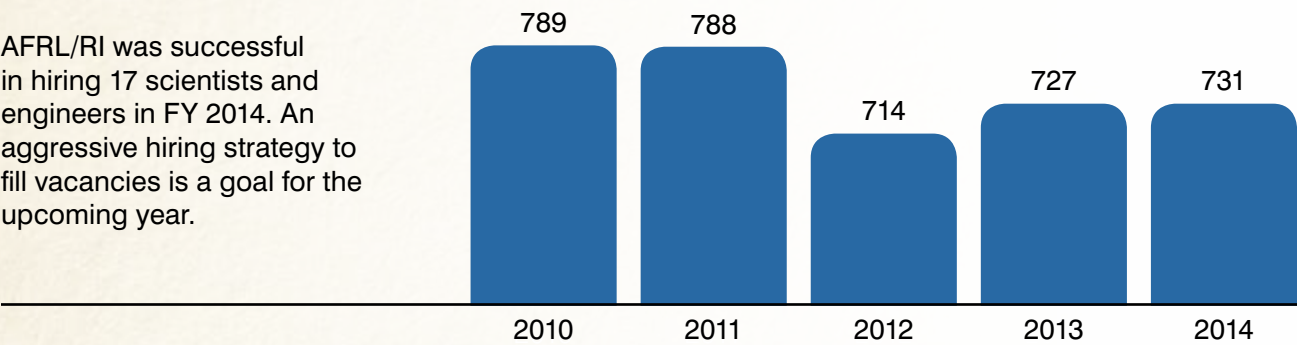
Funds Received

In FY 2014, AFRL/RI received the most funds in the history of the lab. Our commitment and dedication to our customers enables us to leverage the scope and scale of the research with our mission.



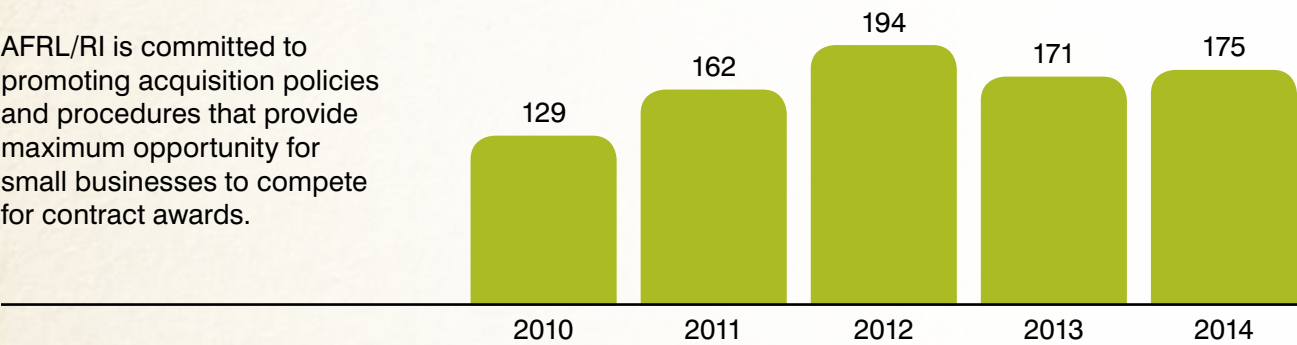
Government Personnel

AFRL/RI was successful in hiring 17 scientists and engineers in FY 2014. An aggressive hiring strategy to fill vacancies is a goal for the upcoming year.

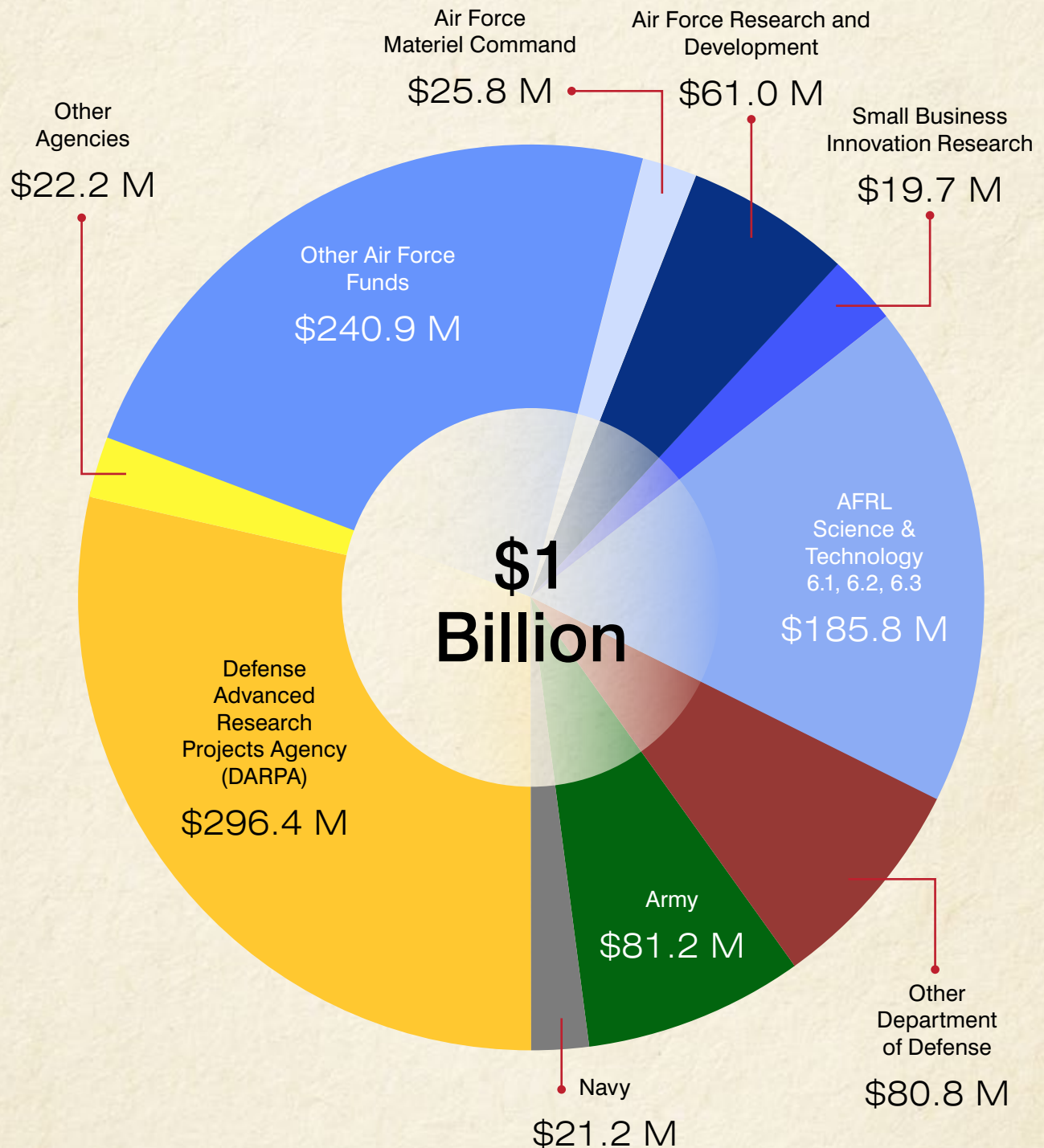


Number of Small Business Contract Awards

AFRL/RI is committed to promoting acquisition policies and procedures that provide maximum opportunity for small businesses to compete for contract awards.



AFRL/RI Funds Received in FY 2014



**\$1.6 B Facility
Net Assets**



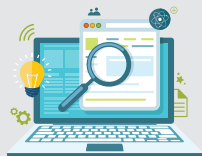
4 Buildings
at Rome Research Site



**1,166
Personnel**



20 Laboratories



**65 Acre
Campus**

at Rome Research Site



**882,000 sq.ft.
floor space**

at Rome Research Site



Rome Research Site Main Campus

Located at the Griffiss Business and Technology Park



Stockbridge Research Site



Used for development of and real world experimentation with advanced radio frequency (RF)/optical communications, networking and information technologies, cyber

techniques and effects, including small unmanned aircraft systems.

- All-weather full season RF Controllable Contested Environment
- C4ISR, Cyber, Spectrum, Networking
- Flexible frequency authorizations
- Heavy-duty turntable with a 200' high arched measurement probe - large aircraft and vehicle capable hemispherical RF/optical system evaluations
- 300 acre flexible test site, varying in relative distance, topology and foliage density



Newport Research Site

Primary mission: To evaluate antenna performance on full scale aircraft and make recommendations for improvement.

- Thousands of antenna patterns measured in 1 rotation of the aircraft
- 10 minutes of testing = more than 100 hours of actual flight testing
- Early procurement cycle measurements save the Air Force millions of dollars
- 10 years of measurements to date on the Air Force, Marine, Navy F-35 versions
- Antenna performance measured for the F-22 fighter and B-1 bomber
- Measurements taken for Army Win-T, GATR Satcom, C130, F-16 antennas
- Newport is a test site for AFRL in-house research, e.g. MIMO, Manpack Satcom

The site consists of 8 measurement ranges, 5 of which are fully instrumented with:

- | | | |
|------------------|--------------------------|-------------------|
| • Signal sources | • Antennas | • High speed |
| • Amplifiers | • Displays | multiplex systems |
| • Computers | • Fiber optic interfaces | |
| • Receivers | • Positioned controllers | |

Largest facility of its kind in the world

Remote Research Sites



Stockbridge Research Site



Newport Research Site



Newport Research Site



Stockbridge Research Site

The Controllable Contested Environment (CCE) located at the Air Force Research Laboratory Information Directorate's Stockbridge Research Site in Central New York State offers an extremely flexible capability for distributed field experimentation. The CCE provides the infrastructure necessary to host field experiments from a wide variety of disciplines. Through this design, the CCE allows for rapid setup and deployment of field experiments by dramatically reducing logistical considerations; enables ease of execution by providing the infrastructure necessary for remote management, instrumentation, and experiment automation; and facilitates sustained experimentation by offering a permanent, securable infrastructure. The CCE consists of a number of spatially distributed pad sites (currently 24 with room for future expansion) located across the roughly 300 acre, undeveloped site.



Stockbridge Research Site CCE Pad Layout

Each pad site consists of a securable, powered, climate controlled, refurbished military shelter placed on a gravel pad. The pad site also hosts utility boxes for power and communication, a high voltage transformer, and two aluminum towers for antenna mounting which range in height from 40 to 75 feet.

The CCE also includes a small Remotely Piloted Aircraft (RPA) test bed capability for rapid and affordable testing and integration of small communications, sensing, and processing payload technologies. Flight tests under this RPA test bed capability operate under approved FAA Certificates of Authorization (CoAs) covering 16 square miles around the Stockbridge Site up to 2,000 ft. above ground level (AGL). Test bed aircraft include both fixed wing and multi-rotor type autopilot controlled airframes and can carry payload systems weighing up to 15 lbs. (airframe dependent) for flight durations up to 45 minutes (airframe and payload dependent).

Small Unmanned Aerial Systems (SUAS) Experimentation

The ability to conduct SUAS related experimentation on a wide range of information technologies provides a cost effective, flexible capability to perform experimentation, evaluation and demonstration of technologies that support the future competencies of the Air Force and the Department of Defense.



Stockbridge Research Site

Facilitating research and development in the areas of communications, networking, cyber, and intelligence, surveillance, and reconnaissance (ISR) technologies encourages and enables real world experimentation in wireless and SUAS technologies.

Collaboration with the Northeast UAS Airspace Integration Research Alliance (NUAIR), based in Rome, NY, provides technology exchange which advances the state of the art in UAS technologies. This collaboration benefits both the government and the commercial world, ultimately providing enhanced capabilities and cost savings.

Core Technical Competencies

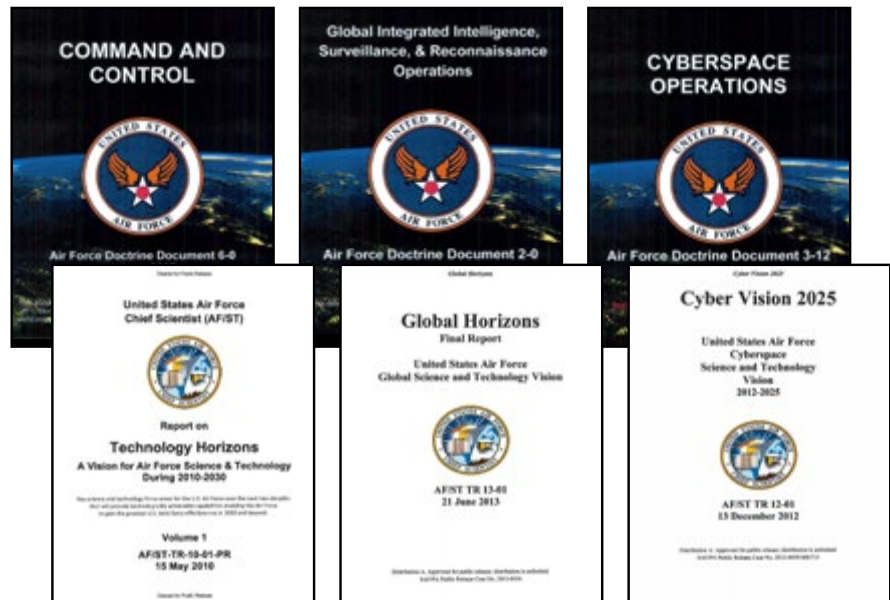
The Information Directorate is a recognized leader in Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber. In order to address the highest priority C4I and Cyber needs of the Air Force, AFRL/RI has a focused science and technology investment portfolio organized in four Core Technical Competencies (CTCs):

1. Autonomy, Command and Control, and Decision Support
2. Processing and Exploitation
3. Cyber Science and Technology
4. Connectivity and Dissemination

To achieve the highest capability needs of the Air Force and support the Air Force vision of Global Vigilance, Reach and Power for the Nation, the Information Directorate invests in science and technology for the future, as well as integrates existing capabilities and mature technologies into innovative, affordable and sustainable solutions.



CTCs address the highest priority capability needs of the Air Force, as documented in *Technology Horizons: A Vision for Air Force Science & Technology During 2010-2030*, *Global Horizons: United States Air Force Global Science and Technology Vision, Cyber Vision 2025: United States Air Force Cyberspace Science and Technology Vision 2012-2025*, Air Force Doctrine Documents, and numerous other documents.



The Information Directorate's science and technology program strives to balance the immediate technology needs of the warfighter with investments in cutting edge science and technology that will lay the groundwork for future warfighter capabilities, while also achieving the 5 strategic vectors for the future described in *America's Air Force: A Call to the Future*:

- Provide effective 21st century deterrence
- Maintain a robust and flexible global integrated intelligence, surveillance, and reconnaissance (ISR) capability
- Ensure a full-spectrum capable, high-end focused force
- Pursue a multi-domain approach to our five core missions
- Continue the pursuit of game-changing technologies

Autonomy, Command & Control (C2), and Decision Support

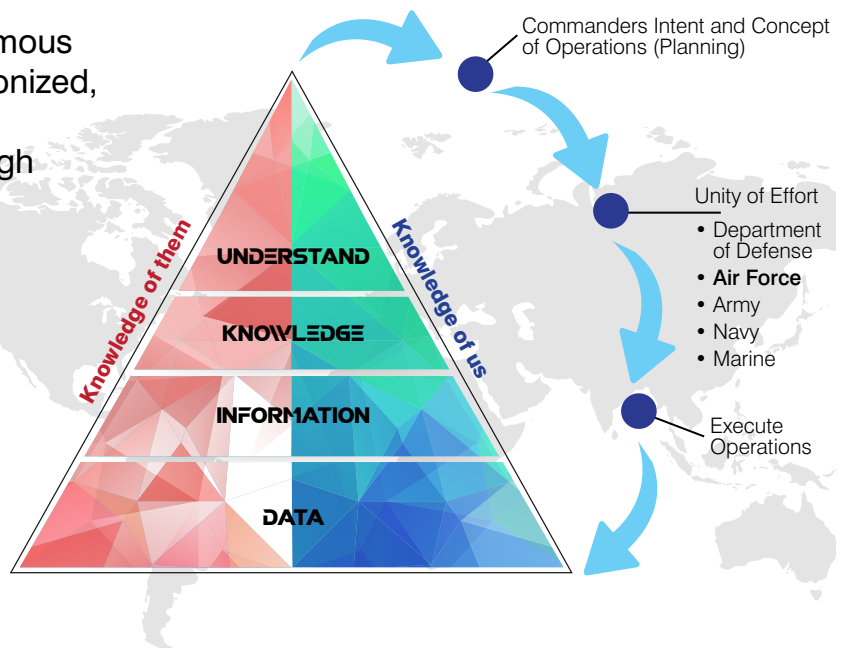
Inventing technologies to realize truly integrated, resilient, and robust command and control systems.

Vision

Trusted, highly autonomous C2 systems for synchronized, multi-domain effects in complex, contested, high tempo conflicts.

Mission

Deliver innovative, trusted, affordable information technologies for agile, resilient, and distributed Air Force command and control systems.



Challenges

- Synchronizing interdependent actions amongst physical and non-physical entities
- Predicting and controlling emerging behaviors of autonomous, decision making systems
- Automated realignment of C2 system functions in contested environments
- Rapidly and continuously assess complex, time-compressed actions
- Multi-domain targeting for synchronized, hybrid effects

Sub Core Technical Competencies

Situation Understanding

To understand the problem, threats, goals, and potential solutions
To constantly OBSERVE the given environment

Continuous Assessment

To monitor execution and measure their results
To OBSERVE, ORIENT, and modify DECISIONS



Mission Focused Autonomy

To ensure our Observe, Orient, Decide, and Act (OODA) is faster, more complete than the adversary's
To compress the loop: autonomous information systems acting as trusted wingmen for human planners and decision makers

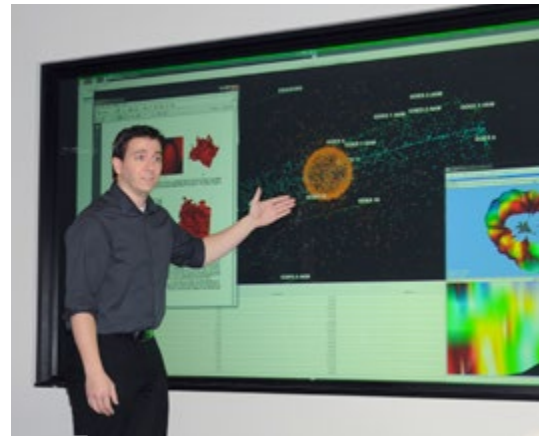
Unified Planning Systems

To integrate air, space, and cyber capabilities for additive effects
To DECIDE and ACT on selected courses of action (COAs)

Featured Facilities

Command and Control Concept Center (C2CC)

Provides an environment to conduct C2 system level experimentation and an evaluation lab using fielded C2 systems of record and their related data sets.



Advanced Visualization and Interactive Displays (AVID)

Supports the development and analysis of concepts in advanced visualization, displays, and human-computer interaction in support of the Integrated C2 concept.

Black Room

Provides a unique opportunity to bring disparate computing resources into a reconfigurable, shared, and interactive space that affords researchers the ability to develop, present, and demonstrate concepts, problems, and solutions in a more data rich context, instead of the typical segmented approaches that are limited by standard system configurations.



See pages 82-83 for all AFRL/RI facilities

Featured Successes



Automated Command and Control Capabilities fielded to National Reconnaissance Operations Center (NROC)

Provided a suite of C2 applications to the NROC to automate their manual processes to the maximum extent possible while allowing for technology to remove non value-added processing steps. Applications delivered include:

1) Information Needs Database: web-based tools to effectively and efficiently catalogue and maintain a repository of corporate knowledge surrounding NROC intelligence requirements needs

2) Watch Integrated Situational Awareness and Reporting Database: web-based tools supporting triage on outages and near real time situation reporting on space assets

3) NRO Advanced C2 Execution Management: web-based tools to support the production, maintenance, query and dissemination of the NRO Space Task Order

The capabilities are estimated to automate 60% of operator tasks while enabling future enhancements through a structured data repository.



Smart Target Folder capability installed at the Air Force Intelligence Analysis Agency (AFIAA)

Delivered to AFIAA a capability to automatically generate content-based metadata to support intelligence analysis and production capabilities. Smart Target Folders continuously monitor structured and unstructured intelligence data sources and provide a cohesive picture of our adversaries and their intents, in time to make a difference.

Processing and Exploitation

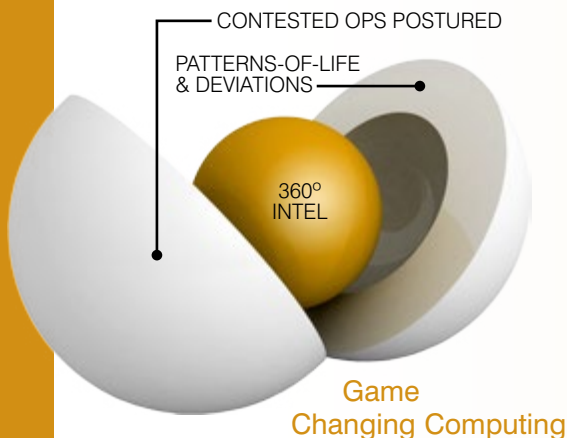
The computing and algorithms behind transforming big data into information.

Vision

Employing massive data analytics for game changing solutions to revolutionize Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber for the Air Force and Nation.

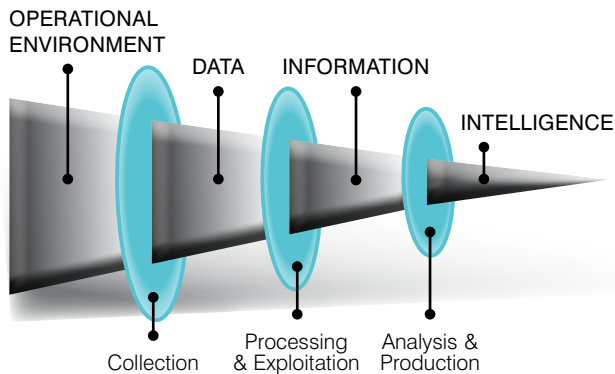
Mission

Lead the discovery, development, and transition of all-source processing and exploitation innovations for the Air Force and Joint communities.



Challenges

- Manage, process, and exploit current massive amounts of intelligence, surveillance, and reconnaissance (ISR) data flows to analyze patterns of life
- Infer relationships and assessment of the current situation
- Exploit targets in denied areas
- Process actionable ISR information via high performance massively-parallel systems
- Energy efficient computing for size, weight, and power constrained at-the-sensor processing

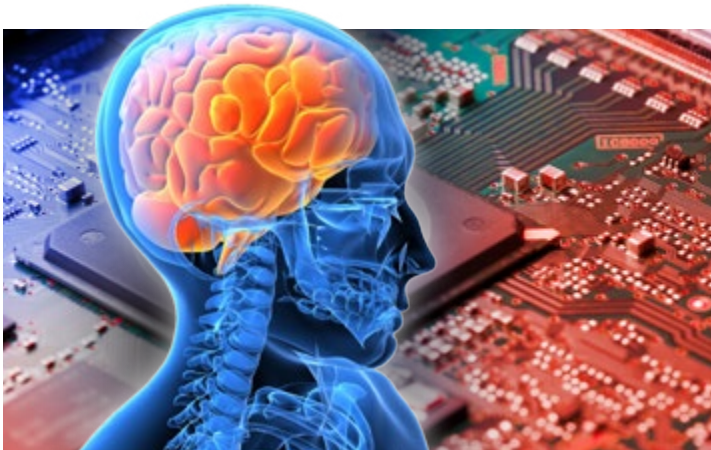
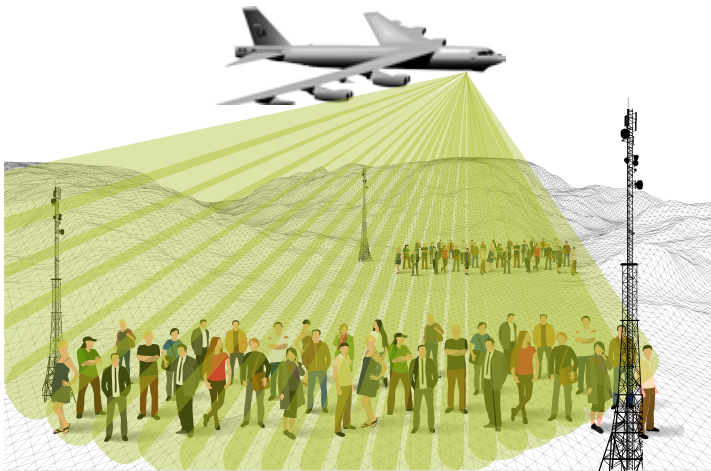


Automated Exploitation

- Detect, locate, and characterize threat signals and signatures in a dense electromagnetic environment
- “We pull signals out of noise”

Multi-Source Analysis

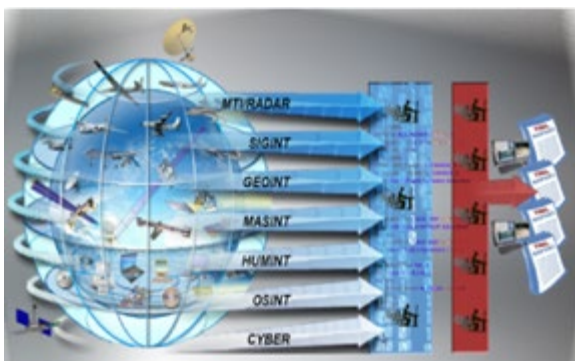
- Automated processing and exploitation capabilities for activity detection, normalcy, and wide-area motion statistics → extended duration tracking and identification
- Text extraction, entity resolution and domain porting of unstructured/semi-structured text → ability to fuse, correlate, and analyze ‘soft’ data sources
- Multiple source intelligence (Multi-INT) Hard/Soft fusion and analysis of dynamic layered data at massive scale



Architectures for Massive Analytics

- Real-time high performance computing
- Neuromorphic computing
- Memristive technology
- Quantum computing

Featured Facilities



Advanced Processing and Exploitation (APEX) Center

Supports analytical studies, conducts on-site and network distributed simulation exercises, and processes real multiple source intelligence (multi-INT) data to facilitate the successful transition of technology solutions.



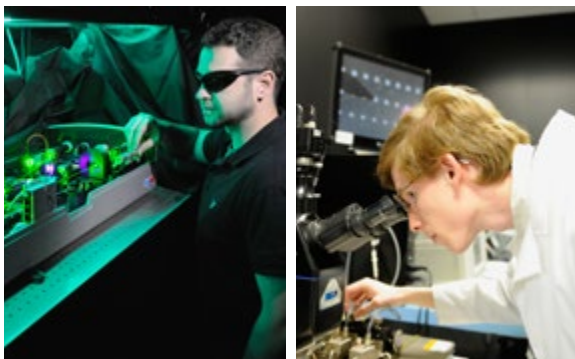
Audio Processing Laboratory

Supports research and development, testing, and integration of speech and audio processing algorithms in support of various intelligence applications that have been delivered to the Army, Navy, Air Force, and Intelligence Community.



High Performance Computing Affiliated Resource Center

Acquires and manages High Performance Computing (HPC) resources as part of its local infrastructure, but shares its resources with the broader DoD user community. Allows for interactive software development and testing on large clusters to provide massively scalable HPC applications.



Quantum Information Science and Nanocomputing & Computational Intelligence Laboratories

The Quantum laboratory supports research and development in the emergent field of quantum information science. Nanocomputing & Computational Intelligence supports advanced nanotechnology research in numerous areas, such as neuromorphic computing, hardware enabled cyber security, nanomaterial and device testing and characterization, hardware based neural networks, and reservoir/chaotic computing.

See pages 82-83 for all AFRL/RI facilities

Featured Successes



Exploitation of Audio tool in operational use at Joint Task Forces location

Provides automated processing capabilities to language analysts performing time-intensive manual tasks. Increases the efficiency and workload production for the linguist, increases exploitation by language of high value targets, and improves accuracy in intelligence production reports in reduced timelines.



Knowledge Association SIGINT Toolkit (KAST) Watchdog transitioned to 55th Wing at Offutt Air Force Base

Near real time automated processing provides immediate alert response time, near real time downlink for reachback enabling virtual crew expansion for analysis, and reduced analysis time ten-fold.



Surveillance Intelligence & Reconnaissance Information System (SIRIS) Used in Combat Operations

SIRIS provides a single location that remotely piloted aircraft operators use to prepare, document, and execute their missions. Users are able to get enhanced situational awareness ("peripheral vision beyond the soda straw") of Full Motion Video.

Cyber Science and Technology

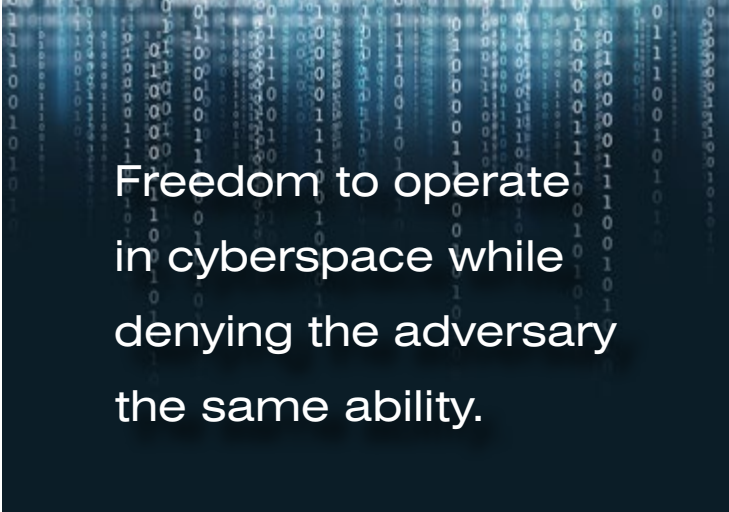
Leveraging and shaping the cyber domain to the nation's advantage.

Vision

Create the future Air Force and Joint service assured operating environments that provide for mission aware and resilient full spectrum capabilities.

Mission

Design, develop and transition innovative cyber capabilities to the Air Force and Joint communities.



Freedom to operate
in cyberspace while
denying the adversary
the same ability.



Challenges

- Full spectrum cyber operations for cyberspace superiority
- Mission awareness for assuring effective missions
- Cyber agility to disrupt/deny adversary attack planning
- Cyber resiliency to fight through and recover from attack
- Hardware & software “Root of Trust” for computational platform assurance



Foundations of Trusted Systems

- Trusted hardware
- Trusted software
- Trusted data
- Assured design



Network Exploitation

- Locate, acquire and process signals of interest, radio frequency (RF) and wired



Cyber Resiliency

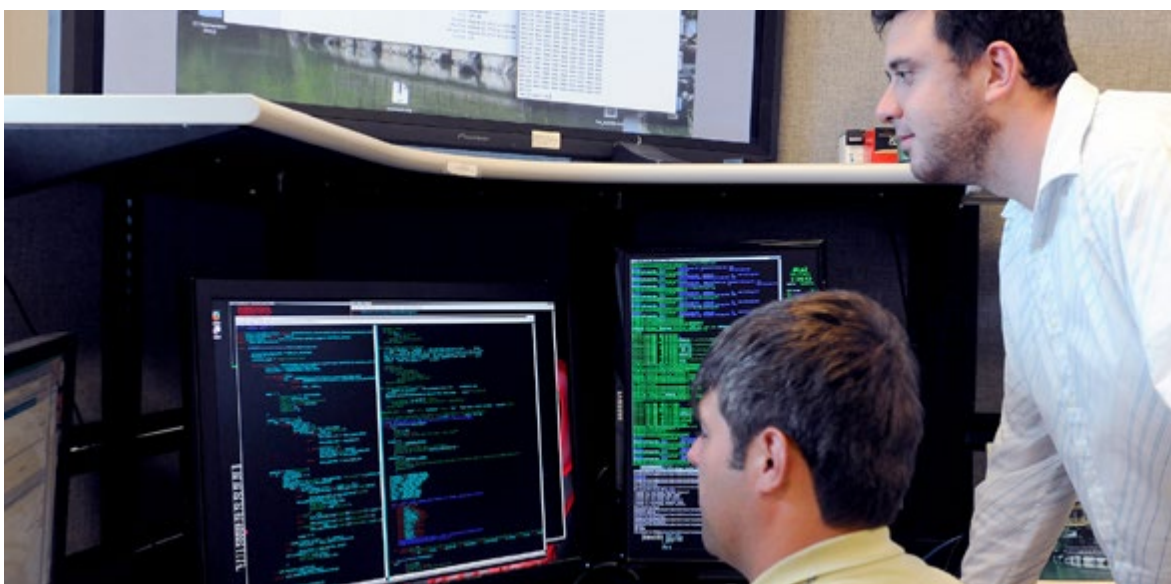
- Maneuver in cyberspace
- Survive and recover in a contested environment
- Mission assurance



Integrated Cyber Operations

- Cyber blending of full computer network environments
- Development of advanced cyber effects, stealth and persistence and large scale experimentation capabilities

Featured Facilities



Cyber Integration and Test Environment

Provides a collaborative workspace for conducting cyber-related research and development, from proof of concept through advanced prototyping. The core focus is to provide a targetable transition platform for technology maturation and operational acceptance by leveraging partnerships with key agencies that support Air Force Network Operations (AFNETOPS). Provides a scalable and feature-rich environment consisting of isolated and interconnected test beds, configuration management, and enterprise services, to develop solutions that will ultimately become fielded capabilities.



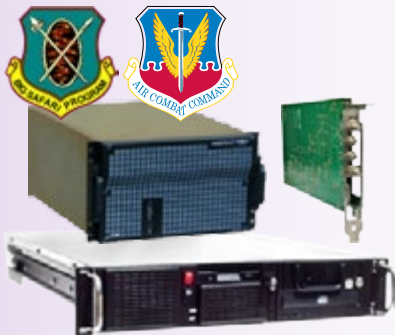
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Featured Successes



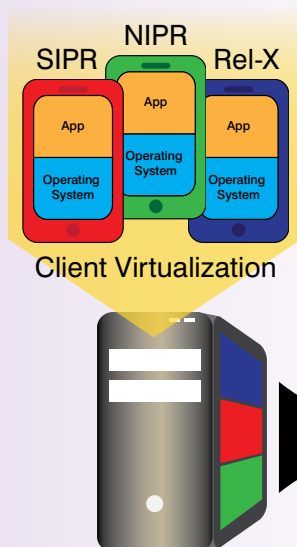
Counter Narcotics Information Sharing Pilot

Developed and demonstrated to Joint Interagency Task Force West an open framework and analytics that provide the counter narcotics community with a holistic, interoperable solution to identify pre-cursor chemical shipments in support of counter narcotics and transnational organized crime.



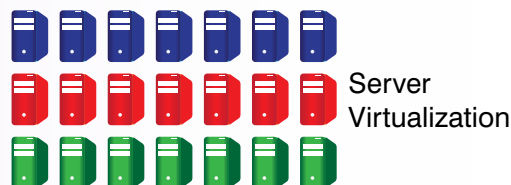
Wolfjaw/Kestrel

Improved symmetric/asymmetric capabilities for airborne intelligence, surveillance, and reconnaissance (ISR). Demonstrated mission success against high value targets in the discovery of and access to priority signals of interest. Hardware and software capabilities delivered and fielded to airborne weapon systems.



Cyber-Based Mission Assurance on Trust-enhanced Hardware (CMATH)

Demonstrated the SecureServe prototype, a secure server virtualization infrastructure, for the Air Operations Center Weapon System (AOC WS) Program Office. CMATH comprises two low cost multi-independent level security virtualization upgrade technologies for client and server virtualization: SecureView and SecureServe.



Connectivity and Dissemination

Putting the right information into the right hands at the right time.

Vision

Seamless networked communications fabric across the C2ISR enterprise – Assuring delivery of timely, reliable, and actionable information to warfighters and systems.

Mission

Provide agile and secure mission-responsive communications and information sharing globally.



Challenges

- Congested, contested and anti-access/area denial (A2AD) operational environments
- Affordable net-enabled C2ISR for tactical and expeditionary capabilities
- Cross-domain security multimedia information sharing
- Mission-aware, on-demand prioritization of information flow

Sub Core Technical Competencies

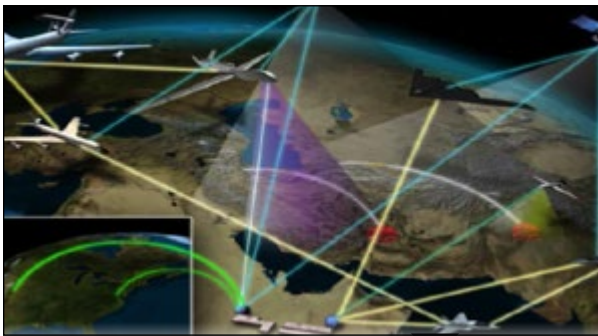


Tactical Information Management & Networking

Providing warfighters an interoperable, affordable, responsive, and sustainable network of networks and information management capabilities to satisfy Service, Joint, Interagency, and Coalition tactical information exchange requirements.

Secure Data Sharing

Securely sharing multiple forms of information (voice, video, text, files, etc.) only with those that have a need to access it and preventing access to information by those that do not need it.



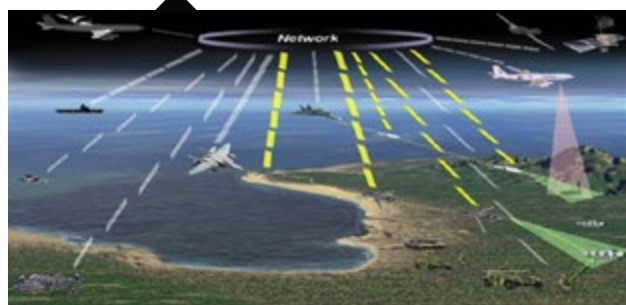
Mission-Responsive Enterprise Resource Management

Developing aerial network and information management technologies that automatically and dynamically sense and react to the mission's changing information requirements and priorities, physical and cyber threat environments and service performance degradation across the enterprise down to the tactical edge.



Data Transmission & Links

Developing secure, survivable, affordable communications links for airborne platforms.



Featured Facilities



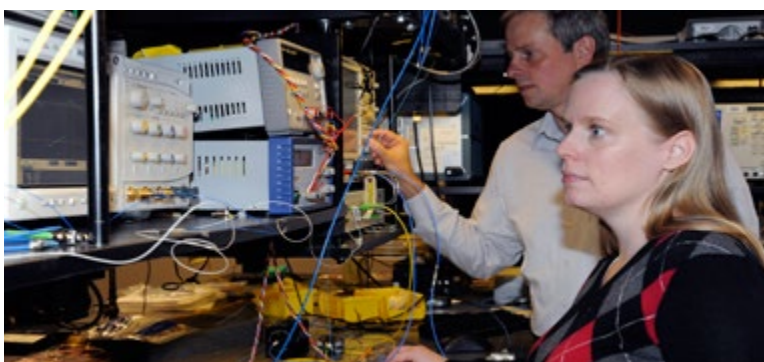
SATCOM Facility

Collects free-space propagation data to enable robust hybrid optical and higher frequency communications in poor/relevant atmospheric conditions.



Integrated Intelligence Innovation Facility

Develops, tests, and showcases cross-domain security technologies that are being used across all services, the intelligence community, and combatant commands.



Quantum Communications Laboratory

Focuses on integrating quantum data encryption and quantum key distribution with high data rates, and free space optical communications with reduced size, weight, and power for secure, high-capacity communication links.



Network Centric Interoperability and Integration Facility

Supports research and development, analysis and integration of a wide range of communications and networking technologies.

See pages 82-83 for all AFRL/RI facilities

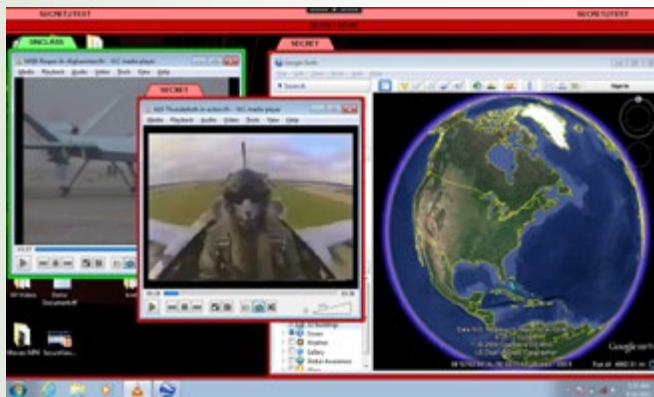
Featured Successes

Android Tactical Assault Kit™ (ATAK™) transitioned to U.S. Special Operations Command (USSOCOM)

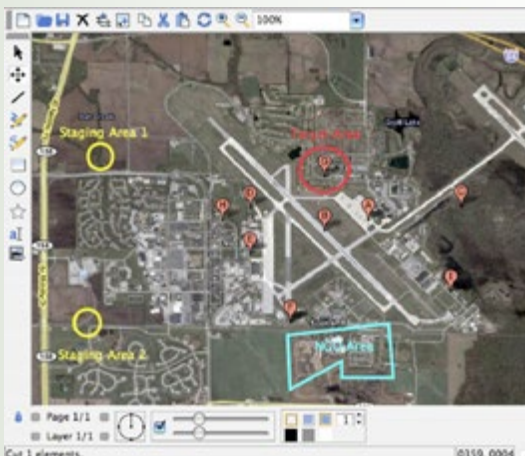
Provides a lightweight handheld tactical device for mission planning, increased situational awareness, and communications with Close Air Support aircraft and Command and Control nodes.



SecureView™ 2.0 used by over 25 operational sites across the Intelligence Community, Air Force, and Federal Government



Consolidates several computers into a single client device, lowering the organizational information technology total cost of ownership by 45-67%. Eliminates the requirement for classified network shielding, enabling multi-domain networking on a single unclassified network.



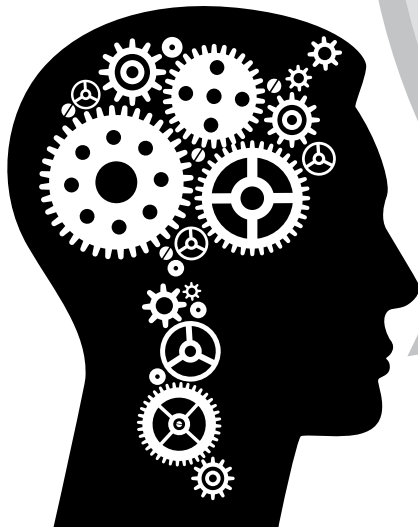
TransVerse Chat Client transitioned to Defense Information Systems Agency (DISA) as the chat client for the Defense Collaboration Service (DCS)

Provides a secure, low-cost, and validated Extensible Messaging and Presence Protocol (XMPP) chat solution to 2 million Department of Defense (DoD) users across classified and unclassified networks.

Collaborations

AFRL/RI's robust portfolio is made possible by collaborating with and leveraging the resources and talents of other services and agencies across the Air Force, Department of Defense, Intel community, and other government, as well as industry and academia.

No organization can accomplish its mission alone, thus the Information Directorate brings them together to augment its own and each other's knowledge base. Since information technology and science is universal, the Information Directorate's collaboration with leading researchers in academia and industry makes it possible to produce cost-effective, affordable, state-of-the-art capabilities that are Air Force relevant but can impact the rest of the world.





See page 81 for a categorized list of FY 2014 Collaborators

Industry Interaction

Tech Expos facilitate supplemental collaboration by developing additional venues for knowledge interchange. Events such as Industry Showcase Day, where commercial technologies are presented to AFRL/RI at the Rome Research Site, provide valuable information transfer opportunities that effectively connect industry and government and strengthen interactions. These events allow for both individual and national service companies (a consortium of enterprises) to display and demonstrate state-of-the-art capabilities and research. As industry developments in Command, Control, Communications, Computers and Intelligence (C4I) and Cyber are shared with the Information Directorate's Scientist & Engineer (S&E) community, the value of information grows into mission focused intelligence.

Highlights in 2014

- National Conference Services Company put on a Command, Control & Communications Tech Expo consisting of 20 companies.
- 5 individual defense companies presented specific capabilities and products at AFRL/RI.

Industry Days provide each of AFRL's Technology Directorates (TD's) with a venue to discuss prospective areas of opportunity for defense contractors. These AFRL sponsored events allow the Air Force and each Technology Directorate to outline strategic plans with regard to current and forthcoming Air Force requirements. Those areas presented by AFRL include: current and emerging areas of research emphasis, recent investment focuses and areas with insufficient resources (i.e. manpower & dollars).

Annual Industry Day(s) events include:

- Wright Dialogue with Industry in Dayton, OH
- Briefing for Industry in Albuquerque, NM



Industry Collaborations

The Air Force Research Laboratory is perpetually focused on promoting and sustaining a mutually beneficial technology based knowledge transfer network. AFRL/RI engages with several professional societies and contributes to their conferences.

This year AFRL/RI played an active role in The Erie Canal Chapter's Armed Forces Communications and Electronics Association (AFCEA) Command, Control, Communications, Computers, and Intelligence (C4I) Technology Review Days.

This conference allowed AFRL/RI's researchers to analyze and identify if military research is keeping up with the fast paced, cutting edge aspects of commercial information technology.

AFRL/RI's Scientist and Engineer (S&E) community delivered several technical presentations.

Attendees were comprised of over 300 technical experts from industry, academia and various government agencies.

The keynote address was given by Major General Thomas Masiello, AFRL Commander.



The Armed Forces Communications and Electronics Association (AFCEA) Conference – Air Force Research Laboratory Commander, Major General Thomas Masiello

Independent Research and Development (IR&D) Technical Interchange Meetings

are structured interactions with industry composed of three phases of activity.

First, industry is briefed on AFRL's research portfolio including current and future Air Force requirements. **Second**, industry is given the opportunity to identify their Independent Research & Development (IR&D) funded capabilities and product improvements for evaluation against Air Force needs. **Third**, the potential for sustained collaboration and knowledge sharing is established with industry in order to continuously influence the capabilities of Air Force applications. These Independent Research & Development events are vital channels for sharing both implicit and explicit knowledge and generating reciprocating progress in mission focused activities.

AFRL/RI's subject matter experts participated in four AFRL sponsored Independent Research & Development (IR&D) events in 2014.

The culmination of these events resulted in the participation of approximately 20 companies providing over 40 technical presentations focused on

- Autonomy, Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber.
- The Aeronautical Enterprise and the Nuclear Weapons Enterprise.

Information Institute

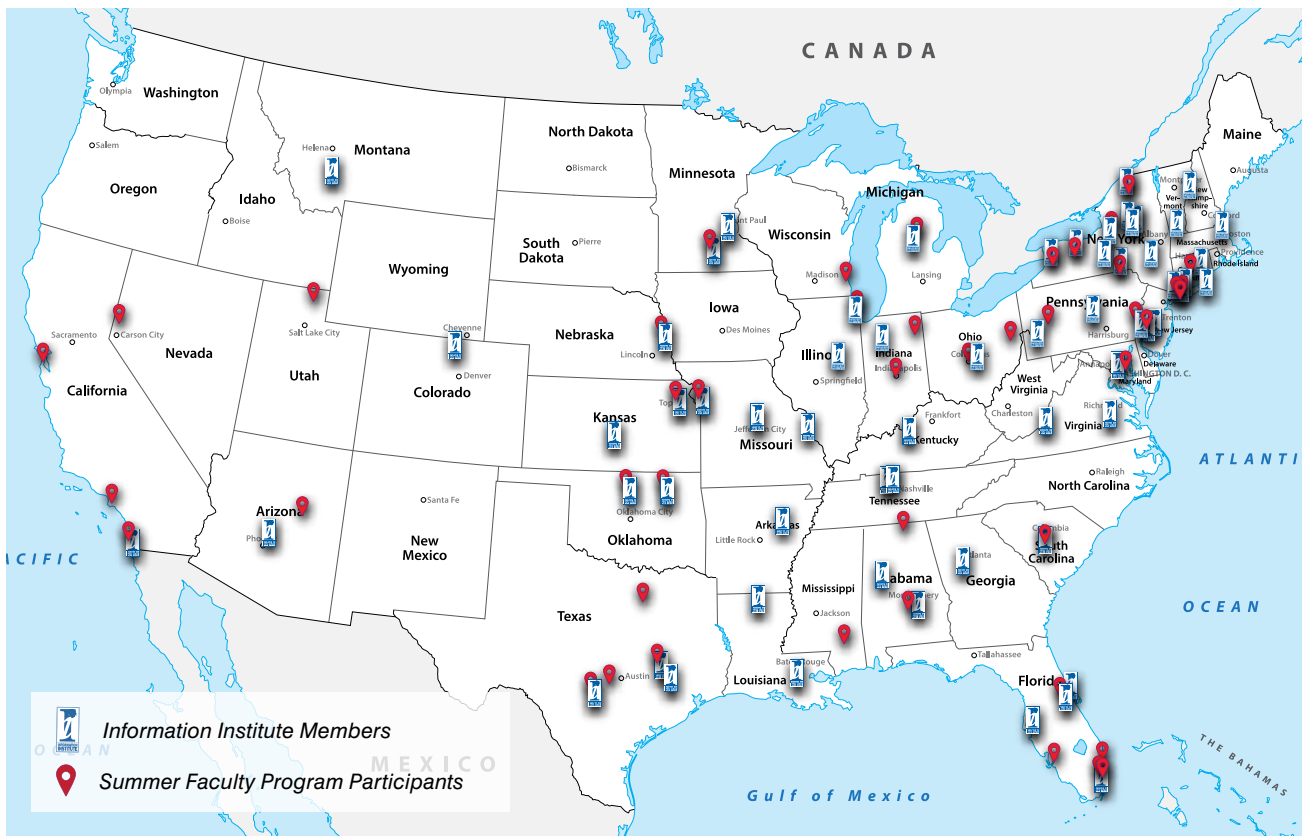


A virtual, collaborative research environment consisting of more than 70 member colleges and universities, 14 of which are located in New York State. The institute provides a unique opportunity for members of academia to work with the U.S. Air Force to advance the state-of-the-art in Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber for the Air Force, Department of Defense and commercial applications. This government-university partnership promotes and expands research in information technology areas of interest to the Air Force.

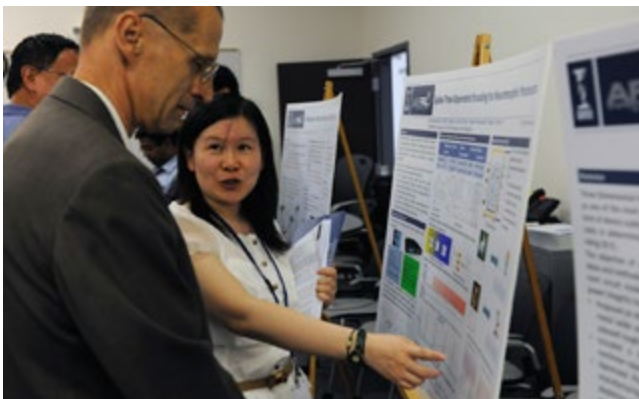
The Information Institute conducts workshops, seminars, lectures and technical exchanges that enhance the Information Directorate's workforce and places them on the cutting edge of new technology trends and innovations. This past summer over 80 visiting faculty, graduate, and undergraduate students performed research with the staff of the Information Directorate. Faculty are selected through national competitions by proposing research tasks in response to research topics that are posted on two web sites and nationally distributed to U.S. academic institutions. Accepted faculty may have the option to sponsor one or more graduate students from their university to assist them in their research. This program represented faculty from 47 different universities from 24 states across the country. Many visiting faculty and graduate students

participated in several technical exchanges and a poster session that facilitated interaction and collaboration with Information Directorate personnel.

The Information Institute hosts networking events to showcase the variety of expertise the summer program affords the Information Directorate. These connections initiate further collaborations which spark grants, publications, awards, and other forms of recognition in support of AFRL/RI and the summer faculty researcher. Extension grants are awarded competitively to the faculty to continue to refine their research at their home institutions. This year 40 extension grants were awarded. Additionally, 37 poster presentations, 21 conference papers, 14 professional journal papers, 9 white papers, 3 book chapters and several field expert topics were presented.



Membership with the Information Institute provides opportunities such as advanced event notifications, early announced summer program information, and first solicitation opportunities for specific project collaboration. Membership is a 5-year, no cost arrangement via an Educational Partnership Agreement with AFRL/RI. Current membership has representation from minority, technical, private and state colleges and universities.



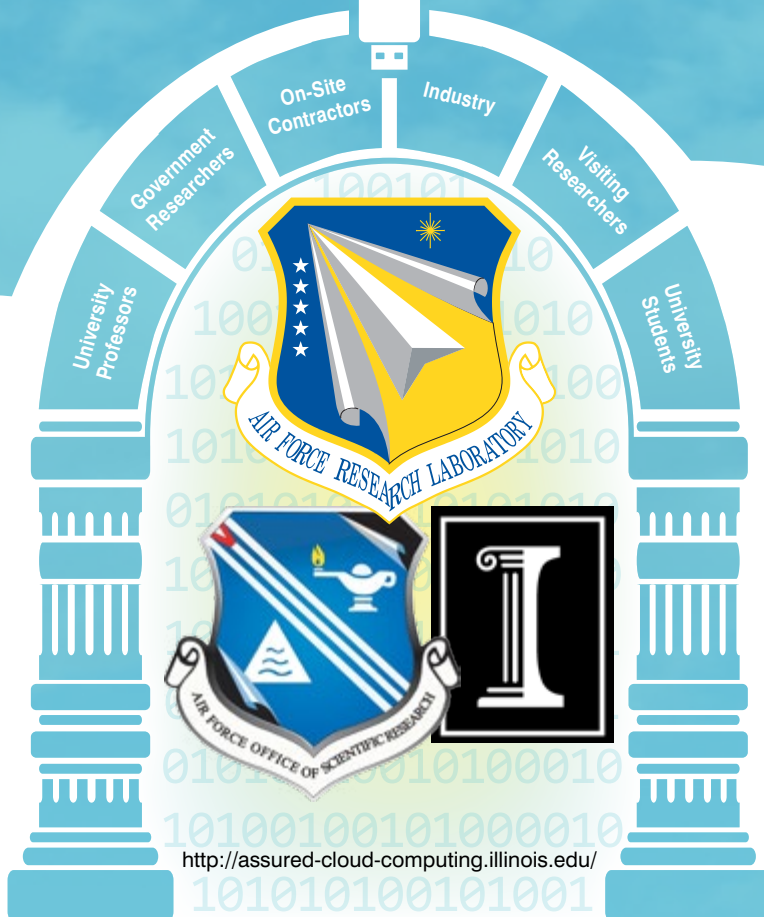
The Information Institute also serves as administrative representation for the National Research Council (NRC) Research Associateship Program (RAP) for fellowships awarded to AFRL/RI and the Summer Faculty Fellowship Program (SFFP) through the American Society for Engineering Education (ASEE) funded through the Air Force Office of Scientific Research (AFOSR).

University Center of Excellence in Assured Cloud Computing

at the
University
of Illinois
Urbana-
Champaign

Established jointly by
AFRL/RI and the Air Force
Office of Scientific
Research (AFOSR).

Purpose:
To advance research
related to information
assurance for virtual
machines and security of
internet or intranet-based
computing.



- Visiting Faculty/Students
- Distinguished Lecture Series
- 56 Publications (2011-2014)
- Monthly Presentations or Short Courses
- Joint Collaborative Research Projects
- Demos Every 2 Years

Preemptive Intrusion Detection:

A model to identify attackers in cyber-physical systems by formally defining monitoring infrastructure, specifying user behaviors and estimating security state of cyber-physical systems using Markov Random Fields. Suspicious users are closely monitored and removed before they are able to launch a cyber attack.

Game Theory with Learning for Cyber Security Monitoring:

Addresses the increasing number and variety of attacks by making predictions on potential attacks while dynamically configuring the security system accordingly.

Broad Range, Purposeful, Textual Inference: Developing a broad range, purposeful semantic inference engine to handle multiple linguistic phenomena and determine, given two spans of text, whether one implies the other and why.

Software-Defined Networking-Based Architecture for Dynamic Inter-Domain Network Virtualization:

Designing and building a dynamic network virtualization framework that deploys and manages virtual networks with minimal, high-level configuration by leveraging software-defined networking.

Self-Protecting Mobile Apps:

Developed an application to monitor a phone's environment (including what apps are running, what services are running, what connectivity options are available) and change the phone's behavior depending on the environment.



Collaborative
Research Efforts

Intellectual Property

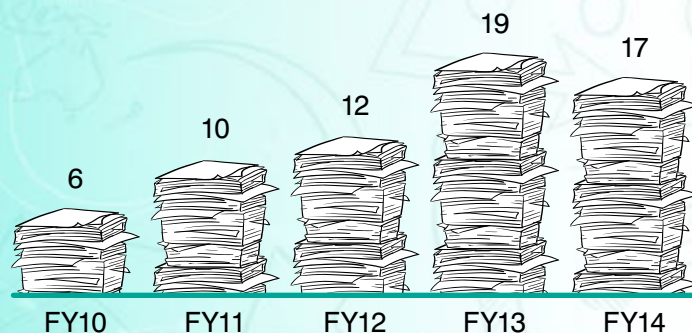


“Innovation has become the principal driver of our modern economy by stimulating economic growth and creating high-paying jobs.”

**— U.S. Patent & Trademark Office,
2010-2015 Strategic Plan**

Patent Applications Filed

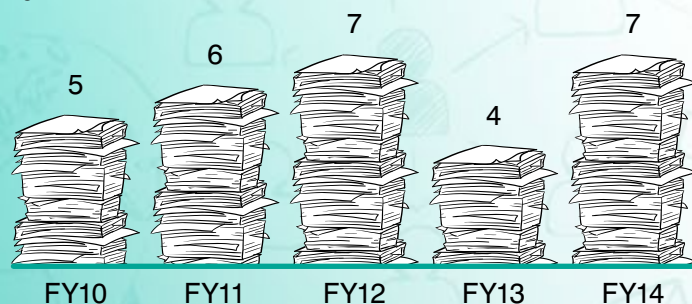
FY 2010 – FY 2014



A filed patent application is examined, analyzing the scope of claimed subject matter to determine whether the claimed invention is new, useful and non-obvious. On average, it takes 18 months for a first action pendency, with the average total pendency over 29 months. However, the pendency period is related to the technology area of the patent application. The information technology area is the most backlogged technical area in the U.S. Patent and Trademark Office.

Patents Granted

FY 2010 – FY 2014



The number of patents disclosed and/or granted is further maximized when taking the cooperative work among AFRL/RI, academia, industry, and non-profit organizations into account. Through the support of federally-funded research and development dollars, the private sector collaborates with AFRL/RI with the goal of achieving the core mission and advancing technology.

Synchronizing Innovation through Academia, Industry & Government



Commercialization Academy

- Commercialization through experiential education
- By providing a venue, resources and support through facilitation, the Commercialization Academy enables compressed, more rapid AFRL/RI technology transfers to the civilian marketplace.
- The delivery of a focused entrepreneurial education through an integrated network of venture capitalists, industry, government, and academic professionals enables the expansion of technical and commercial channels to the market.
- Satisfying the goal of creating local small businesses from laboratory intellectual property will establish a link between public, private and academic experts and create a platform for a sustained technical community.

<http://commercializationacademy.org>

Mohawk Valley NYS Certified Business Incubator

- Established at the Griffiss Institute, a Partnership Intermediary with AFRL/RI.
- Will link numerous regional cyber-security assets and business development programs into one unified program.
- Will assist start-up businesses in the Mohawk Valley by deploying best practices and providing mentorship programs, business related services and linkage to other economic development programs.

<http://esd.ny.gov/nystar/TechnologyIncubators.asp>

Northeast UAS Airspace Integration Research Alliance (NUAIR)

- NUAIR is composed of approximately 40 public, private, and academic communities from New York and Massachusetts.
- Partnerships between AFRL/RI and NUAIR have been formalized through a Cooperative Research and Development Agreement (CRADA).
- Collaborative Focus: Together AFRL/RI & NUAIR will collaborate in the research, development and data analysis of data links, link encryptions, communications, flight control and sense and avoid technologies for Unmanned Aerial Systems (UAS).
- AFRL/RI at Stockbridge: AFRL/RI has been steadily involved in flying experimental packages on its UAS at its Stockbridge Research Site and in restricted airspace at Fort Drum. Emerging efforts to expand UAS mission scenarios into a typical operational scenario are underway (through Certificates of Authorization) in order to expedite the expansion of flight test capabilities at the Stockbridge Research Site.



Commercialization Academy students studying the AFRL/RI patent wall

New York's Nanotech Corridor

University Based Research:

At the center of New York's nanotech corridor, a research-based effort, is the State University of New York (SUNY) representing the largest university system in the United States with a research budget of approximately \$1 billion [1]. In March 2014, the SUNY Board of Trustees approved a merger which combines SUNY College of Nanoscale Science and Engineering (CNSE) and SUNY Institute of Technology (SUNYIT), forming SUNY Polytechnic Institute (SUNY Poly). [2]

The **Relationship** between AFRL/RI and SUNY Poly formalizes collaboration in the broad area of hybrid electronics, with a particular focus on the intersection of nanotechnology and cybersecurity.

Nanotechnology & New York State:

Investments in academic research infrastructure and collaborative engagements with private industry and regional development agencies have established the state of New York as the gravitational center for nanotechnology and the semiconductor industry.

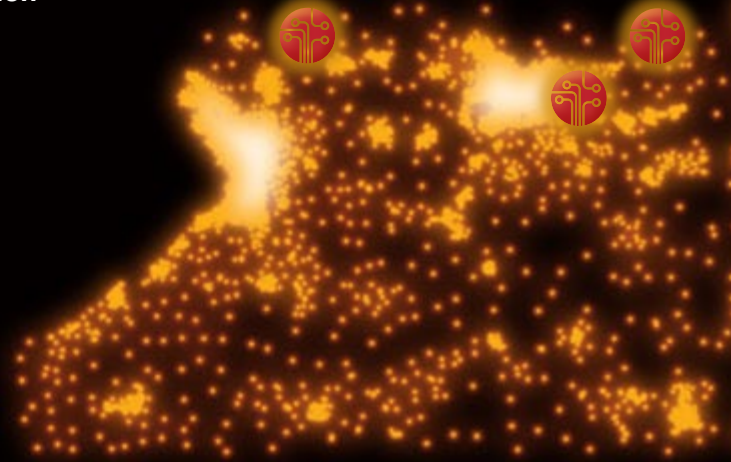
Technology Transfer:

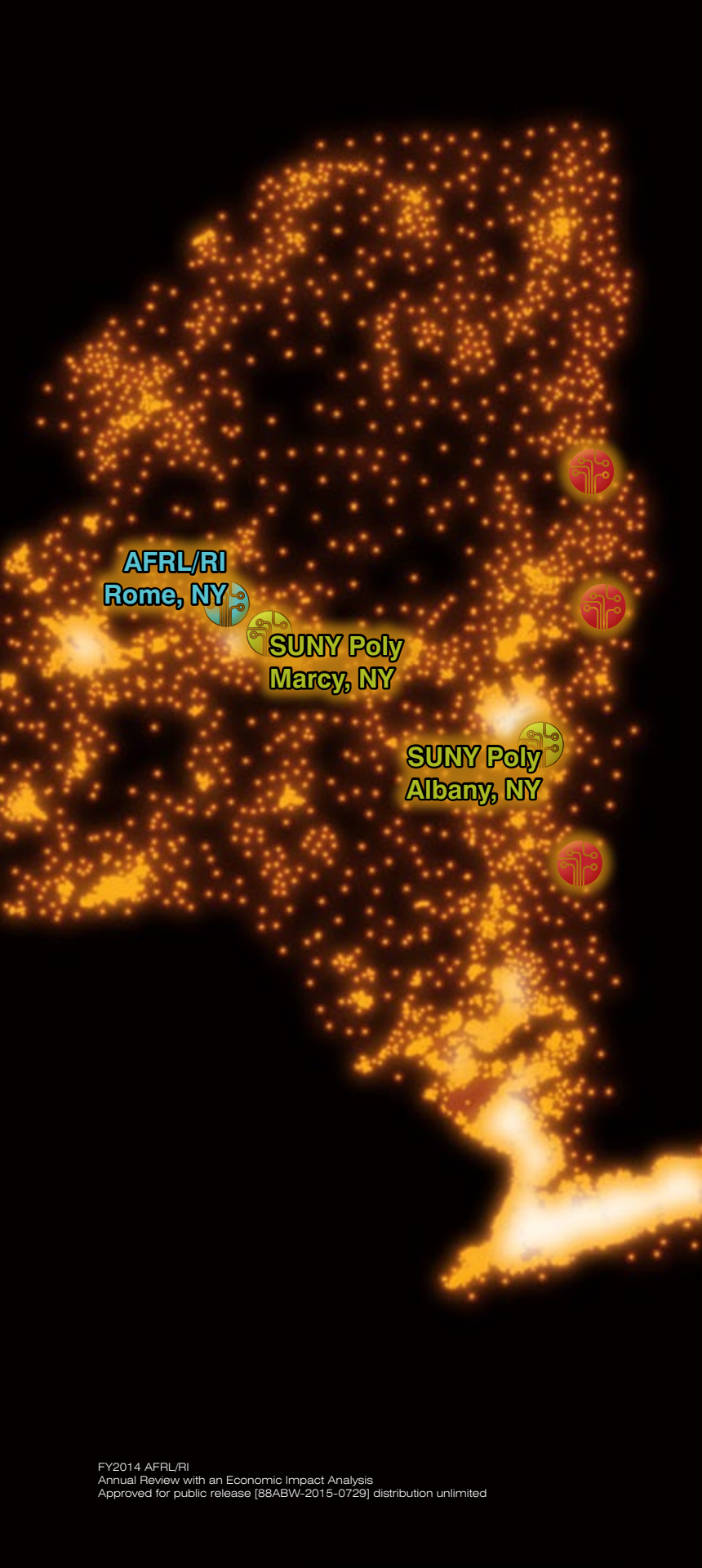
As AFRL/RI continues to pursue technology development in hybrid electronic systems, expertise in latter stage efforts such as packaging, testing and manufacturing associated with delivery and operational transition become a priority. These areas represent a research gap fitting the capabilities of the soon to be opened SUNY Poly computer, chip, commercialization center (Quad-C) facility in Marcy, NY. Areas of particular interest to AFRL/RI include testing, packaging, and Electronic Design Automation (EDA) tools for fabrication of 3D integrated circuits (3D IC's) that account for 3D chip stacking from the beginning of the design flow.

References:

[1] National Research Council (US) Committee on Competing in the 21st Century: Wessner CW, editor. Best Practices in State and Regional Innovation Initiatives: Competing in the 21st Century. Washington (DC): National Academies Press (US); 2013. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK143000/>

[2] Ference, S. (2014, September 10). SUNYIT: News and Announcements. Retrieved September 10, 2014, from SUNYIT: http://www.sunyit.edu/apps/blogs/news/2014/09/09/state-university-of-new-york-trustees-unanimously-approve-suny-polytechnic-institute-suny-poly-as-new-name-for-merged-suny-cnse-sunyit/?utm_source=rss&utm_medium=rss&utm_campaign=state-university-of-new-york-trustees-unanimously-approve-suny-polytechnic-institute-suny-poly-as-new-name-for-merged-suny-cnse-sunyit





**1 AFRL/RI employee
embedded full-time
in the area of
nanotechnology on site
at SUNY Poly Albany
Campus**

**Benefit to the
Air Force Mission:**

The broad research objective of this relationship is the development and testing of new, powerful technologies to benefit the Air Force, Department of Defense, and private sectors to meet both military and civilian applications. AFRL/RI will benefit from the presence of SUNY Poly research staff that will participate in enhanced design, testing and transition of hybrid electronics to future AF systems, as well as the advanced research, development, and technology testing infrastructure being established at SUNY Poly. AFRL/RI will also benefit from a

pipeline of new engineering and scientific talent emerging from SUNY Poly, with engineering, computer science, and natural science degree programs targeted towards the Information Directorate's needs.

Griffiss Institute



The Griffiss Institute (GI) is a nonprofit corporation established by the State of New York. As the Information Directorate's partnership intermediary, the GI assists in the following areas:



- Technology Transfer
- Workforce Education and Training Programs
- Science, Technology, Engineering and Mathematics (STEM) education

Technology Transfer:

The GI achieves technology transfer by facilitating cooperative research and development agreements (CRADAs) with private industry and other federally funded laboratories, commercial test agreements (CTAs) with customers requesting assistance in product validation/verification, and educational partnership agreements (EPAs) with universities.

<http://www.griffissinstitute.org>



Workforce Education and Training Programs:

Professional development through training programs for laboratory personnel in software development and program management certification.

STEM Education:

The GI is focused on a multitude of community outreach activities from involvement in the annual Air Force Association competition, Cyber Patriot, and robotics, to the yearlong Dimension U competition with middle and high school students. The Information Directorate received the prestigious 2014 Federal Laboratory Consortium for Technology Transfer National STEM Award based upon the teaming of the GI and AFRL/RI workforce.



Small Business

It is the policy of the Federal Government to provide maximum practicable opportunities in its acquisitions to small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns. Such concerns must also have the maximum practicable opportunity to participate as subcontractors in the contracts awarded by any executive agency, consistent with efficient contract performance. The Small Business Administration (SBA) counsels and assists with small business concerns and contracting personnel to ensure that a fair proportion of contracts for supplies and services is placed with small business.

Featured Success:



White House Situation Room

Web-enabled Temporal Analysis System (WebTAS)

Web-enabled Temporal Analysis System (WebTAS) is a framework that provides integration, visualization, analysis and production of actionable information across disparate data sources, user communities and missions. WebTAS was developed by Intelligent Software Solutions, Inc. (ISS) over the last 15-20 years. ISS won the initial contract as a small

business and due to its successful technology has grown into a large business. This collection of proven software used to rapidly construct and field new solutions is operated by numerous customers across diverse communities and domains. This includes over 20,000 users worldwide amongst Air Force intelligence and command and control, numerous Combatant Commands, Army, Navy, Coast Guard, Department of Homeland Security, and Intelligence Community agencies. It is being used in the White House Situation Room to gain insight into the success of our campaigns overseas. In its ever expanding role, WebTAS and its software components will now be deployed with the United States Africa Command (U.S. AFRICOM) to be used as an Information Reporting Solution for Operation Unified Assistance to combat Ebola in western Africa. The system will include multilingual database accessibility via web browser and mobile devices as well as being used to collect, report, analyze and share data on the status of the African Ebola outbreak.

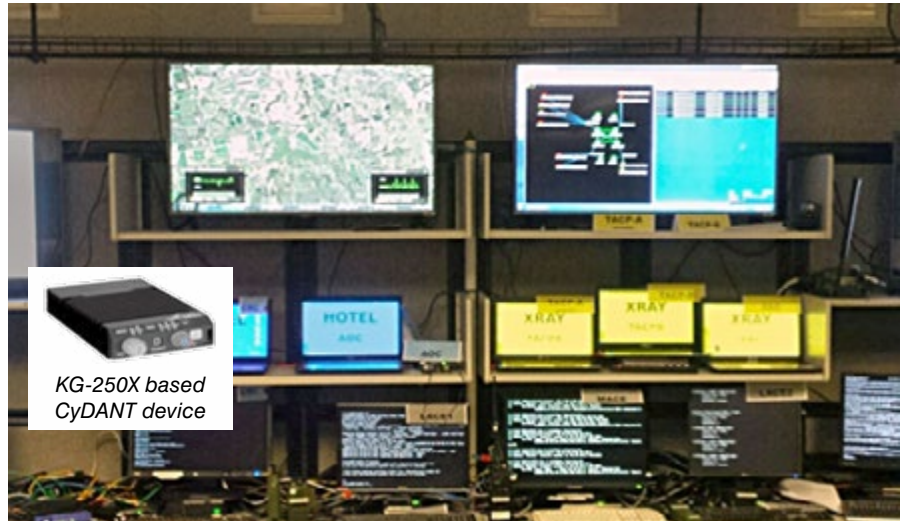
Small Business Innovation Research (SBIR)

AFRL/RI obligated \$317 M to small businesses in FY 2014. This equates to over 37% of all contractual obligations!

Presidential Proclamation

National Small Business Week, 2014

Small businesses represent an ideal at the heart of the Nation's promise - that with ingenuity and hard work, anyone can build a better life. They are also the lifeblood of our economy, employing half of our country's workforce and creating nearly two out of every three new American jobs.



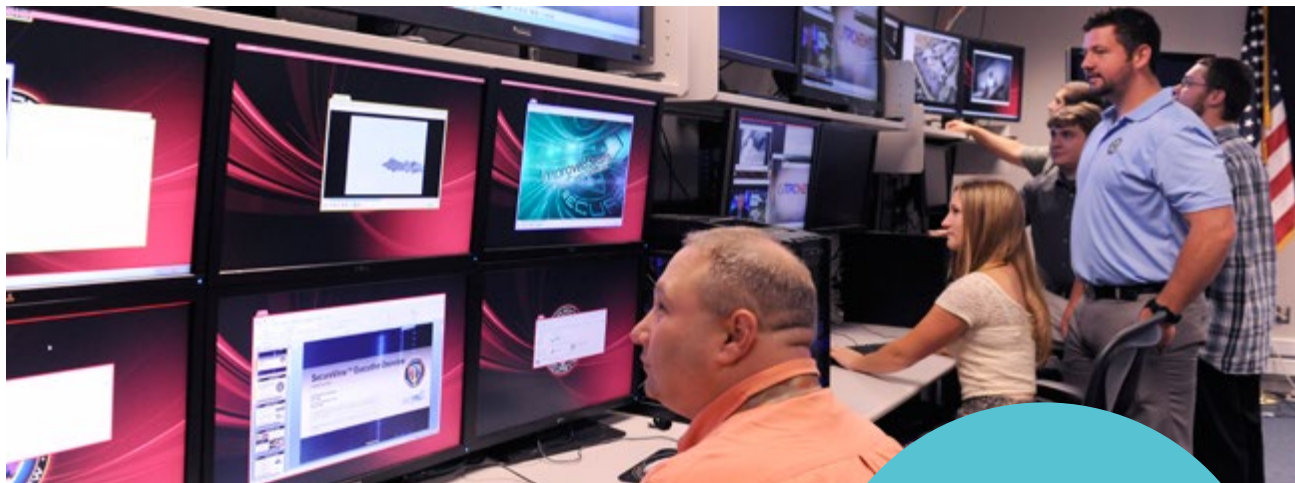
Laboratory demonstration of CyDANT capabilities at AFRL/RI used a variety of real tactical radios integrated within the network testbed depicted above.

SBIR Technologies Produce Cyber-Defensible Aerial Networking Technology (CyDANT) prototype

In September 2014, Architecture Technology Corporation (ATCorp), a small business headquartered in Minnesota, along with its subcontractor ViaSat, Inc., conducted a laboratory demonstration of Cyber-Defensible Aerial Networking Technology (CyDANT).

Combining the results of six different SBIR efforts focused on aerial networking, CyDANT is developing software enhancements to ViaSat's KG-250X compact and ruggedized high assurance internet protocol encryptor (HAiPE) to produce a Technology Readiness Level 6 prototype of a multi-function device, i.e., network encryptor and tactical IP router. The CyDANT device will enable the Air Force to realize a mission assured internet in the sky for transporting full-motion video, voice-over-IP (VoIP), images, text chat, file transfer, web browsing and other mission data exchanged among airborne and ground users. This is vital for bringing network centric warfare to the air.

Shaping the Scientist & Engineer Workforce



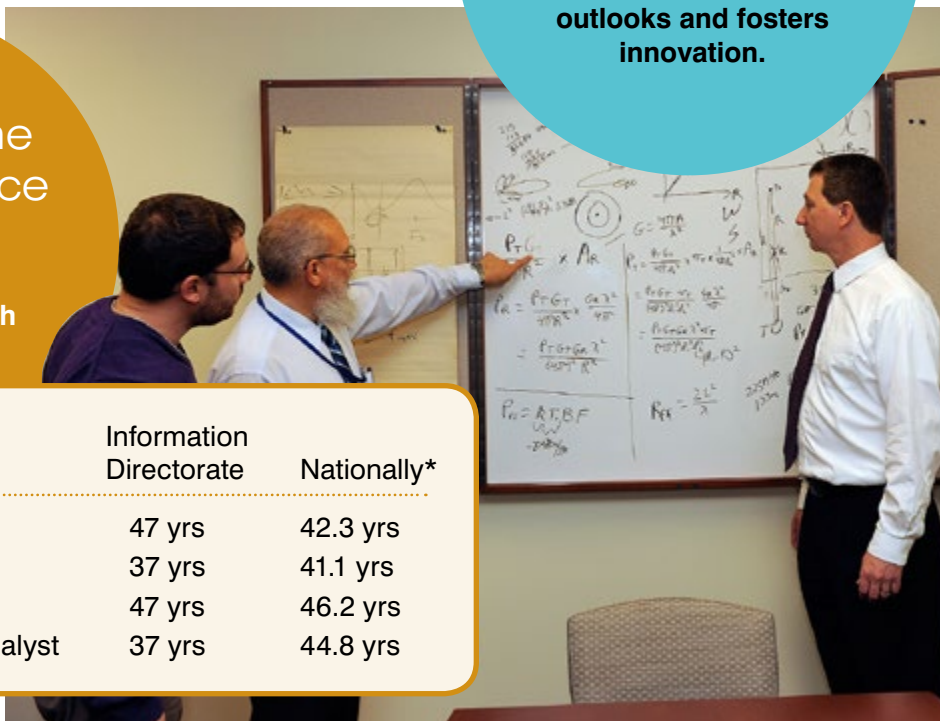
Over 160 academic institutions are represented by the Scientist and Engineer workforce of 361. Those institutions span 39 states and 6 countries.

Academic Diversification

**Thinking differently
creates fresh
outlooks and fosters
innovation.**

Balancing the S&E Workforce

**The benefits of a
multigenerational
workforce outweigh
the challenges.**

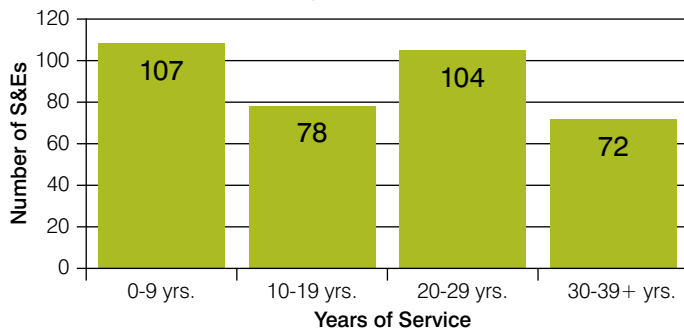


Median Age by Job Category

	Information Directorate	Nationally*
Computer Engineer	47 yrs	42.3 yrs
Computer Scientist	37 yrs	41.1 yrs
Electronics Engineer	47 yrs	46.2 yrs
Operations Research Analyst	37 yrs	44.8 yrs

*source: Bureau of Labor Statistics
http://www.bls.gov/cps/occupation_age.htm

Scientist and Engineer (S&E) Years of Service



The average years of service is 18 years. This average has been maintained for the past 5 years.

Delivering the Mission with Perseverance

Serving with passion, skill and professionalism.

86 Scientist and Engineers have been hired in the last 5 years.

Conduit of Talent

Directorate needs are identified through workforce planning. Critical job roles are filled based on knowledge, skills and attributes needed.

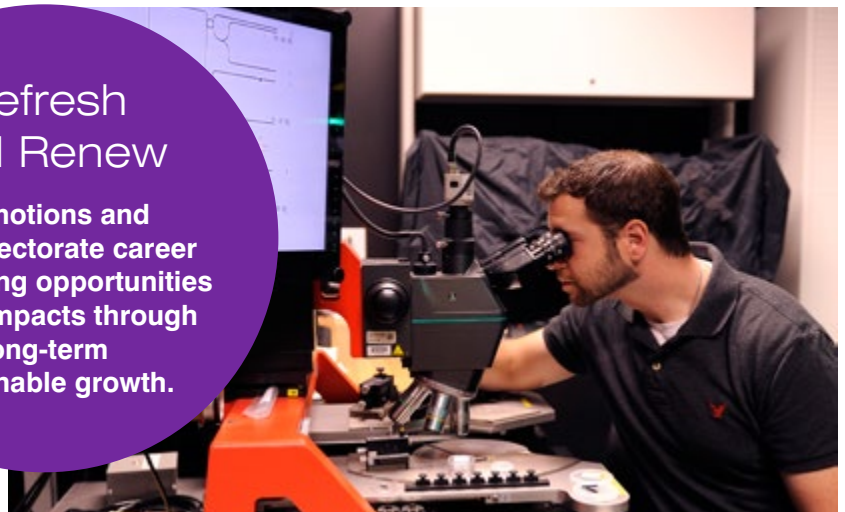


7% of the Scientists and Engineers were promoted in FY 2014.

4.4% chose a fresh start by taking advantage of career-broadening opportunities within the lab.

Refresh and Renew

Promotions and intra-directorate career broadening opportunities create impacts through long-term sustainable growth.





The Fabrication Shop

Efficient Use of Precious Resources

The AFRL/RI Fabrication Shop is always “Open for Business”. Comprised of seven specialty areas and 19 multi-disciplined craftsmen, the Fabrication Shop has the capabilities of a large facility with a responsive, flexible and reliable small facility feel. The craftsmen build prototypes; modify and repair; extend the useful life of a piece of equipment, or turn that piece of equipment into another useful asset. Their craftsmanship enables AFRL/RI to focus its precious resources on its mission in the most efficient way possible. They can take an idea from concept to prototype to demonstration. This “one-stop-shop” is a “full service solution” and is located on-site.

If you can dream it, they can build it!

■ The Fabrication Shop’s seven specialty areas include:

Machine Shop

Repair metals, composite parts, and equipment

Sheet Metal Shop

Roll metal and manufacture compound contours

Electric Shop

Formulate layout of required electrical circuits, including relays, interlocks, motors and lighting

Paint and Sign Shop

Interior/Exterior signage

Welding Shop

Manipulate most metals. Specializing in steel, stainless steel, titanium, and aluminum

Pattern Shop

Custom consoles, millwork, and cabinetry

Plastic Shop

Modeling of existing components for lighter-weight uses



Idea:

Repurpose a **surplus** shelter to provide a flexible, environmentally controlled enclosure, as part of a larger experiment and test enterprise.

Concept:

Refurbish and retrofit the shelter with the necessary capabilities; specifications provided by the scientists and engineers. Use in the field at the remote research sites.

Prototype:

The refurbished shelter was retrofitted with electrical, climate control and equipment mounting. Placed at the Stockbridge Research Site and outfitted with communications, the renovated shelter became operational.

Demonstration:

Thirty surplus shelters have been acquired from the Defense Logistics Agency Disposition Services, Hill Air Force Base. AFRL/RI acquired them at no cost. 24 have been completed and are in operation at the Controllable Contested Environment test range at the Stockbridge Research Site. Each shelter is securable, powered and climate controlled.

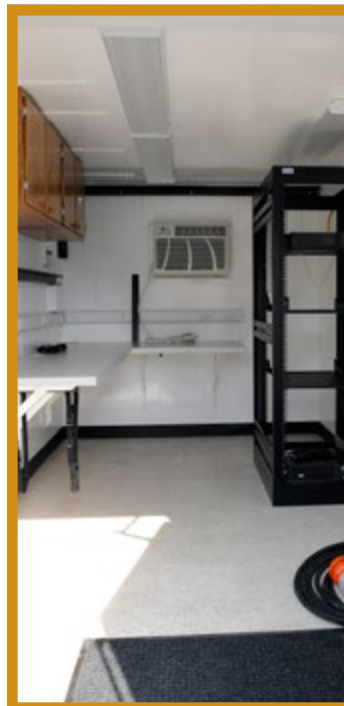
The cost of a **new** shelter is approximately \$55,000 each.

The cost of a **refurbished** shelter (to the quality of a newly purchased one) is less than \$5,000 each.

Total cost savings to AFRL/RI:
\$1,500,000+.

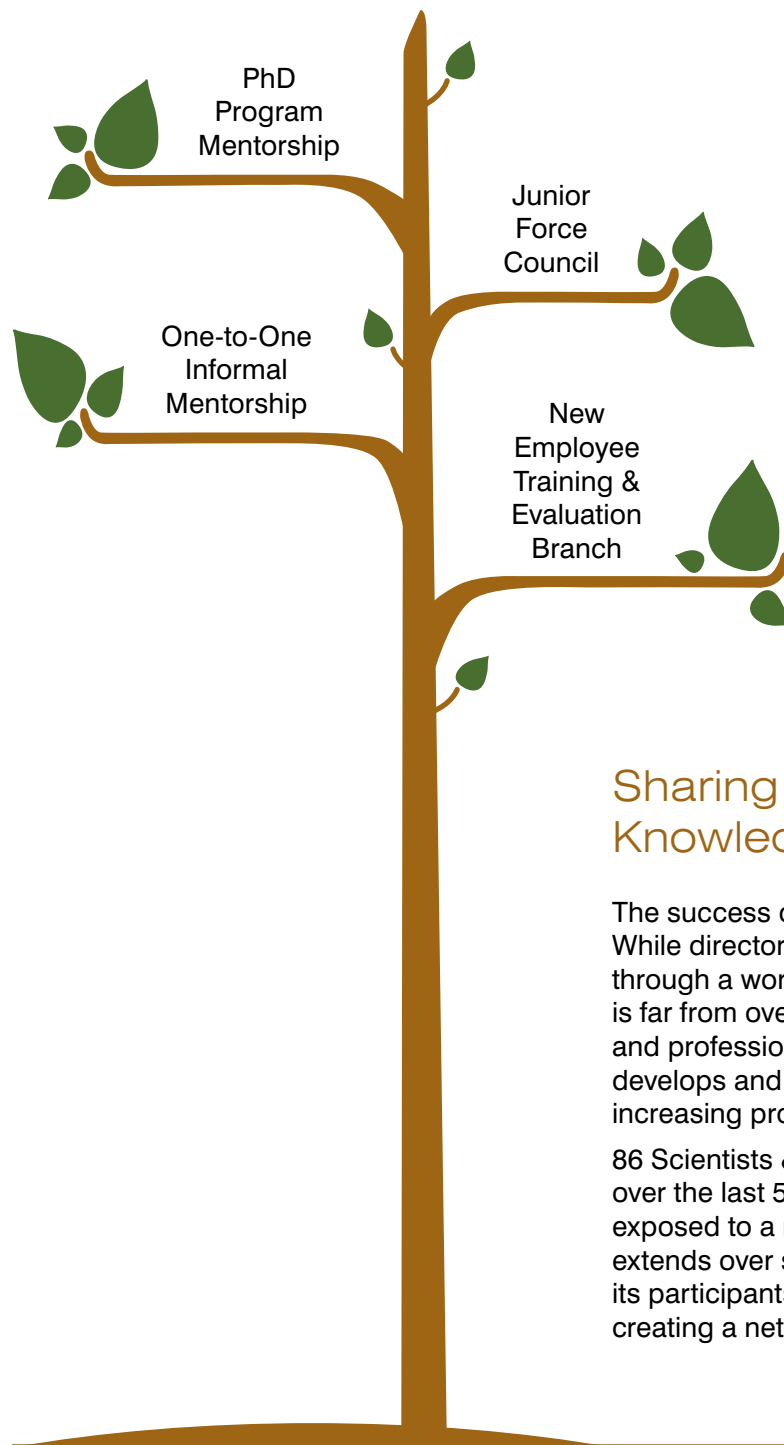
Innovation in Action

Featured Project: Test Range Shelters



Workplace Mentorship

Human talent is the Information Directorate's most valued asset. Commitment and dedication to the leaders of tomorrow takes time, resources, and energy. The return on this investment is infinite.



Sharing More Than Knowledge

The success of our laboratory lies within its people. While directorate needs are identified and filled through a workforce planning process, the process is far from over once an individual is hired. Training and professional development attracts, motivates, develops and retains junior employees – all while increasing productivity and job satisfaction.

86 Scientists & Engineers (S&Es) have been hired over the last 5 years. From the onset, they are exposed to a multi-faceted mentorship program that extends over several years. This approach enables its participants access to a variety of fresh ideas, creating a network of mentors.



PhD Program Mentor

PhD Program Mentorship:

Intended to help individuals be successful in pursuit of their advanced degree, a genuine interest is taken in an individual's continuing education as well as professional and personal development.



Junior Force Council (JFC):

The overall mission of the JFC is to provide its members the means to develop personally and professionally. It was established to identify and

address the concerns of the junior level workforce by serving as an advisory board to AFRL/RI senior leadership. Members of the Junior Force consist of junior military and civilians who have ten or fewer years of service.

The council promotes issue resolution and professional development initiatives.

New Employee Training and Evaluation Branch:

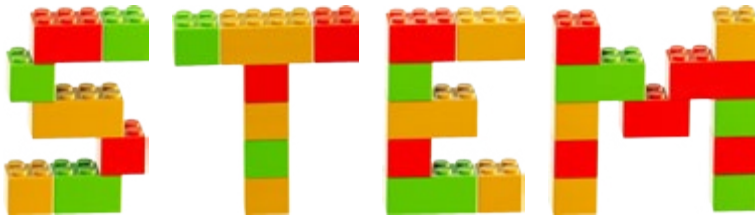
Scientists and engineers hired into the branch receive the opportunity to work with up to three different senior mentors over the course of their first two years of employment. Projects are focused on giving the new employee hands-on experience while making a direct contribution to the mission of the directorate and the greater Air Force. Numerous training opportunities are offered throughout the two years, preparing them for their future as AFRL/RI researchers.

One-to-One Informal Mentorship: The core of the mentoring process is still the traditional relationship between the mentor and mentee. It leads to productive long term relationships based on respect, trust and a mutually shared objective.



Newly hired employees have opportunities to attend "bluing trips" giving them exposure to the operational side of the Air Force. This helps them understand the challenges in the field and how the research and development they are undertaking can help overcome those challenges.

Junior Force Bluing Trip, Nellis Air Force Base, Nevada



Science, Technology, Engineering & Mathematics

Building a platform for Sustained Innovation: Education for Global Leadership

President Obama continues to set challenging goals to improve STEM based education in America. STEM focused programs have become increasingly significant, standing to represent the key to our nation's economic future. One component of the Obama Administration's comprehensive effort is the 5-year Federal STEM Strategic Plan. This plan consists of five priority STEM education investment areas. The Information Directorate, a longtime proponent of STEM, is directly involved with programs in each of these 5 areas. AFRL/RI has exhibited commitment, strength and resilience in efforts to "Improve STEM Instruction" and "Increase and Sustain Youth and Public Engagement in STEM". From grade school to graduate school, AFRL/RI's STEM programs have extended the demographic and geographic coverage of STEM participation across New York State and around the Nation. AFRL/RI's scientists and engineers are creating "eureka moments" and simulating "real world" experiences with hands-on, project-based STEM programs.



Cyber Summer Camp

5-year Federal STEM Strategic Plan Priorities and STEM Education Investment Areas

- Improve STEM Instruction
- Increase and Sustain Youth and Public Engagement in STEM
- Enhance STEM Experience of Undergraduate Students
- Better Serve Groups Historically Under-represented in STEM Fields
- Design Graduate Education for Tomorrow's STEM Workforce

http://www.whitehouse.gov/sites/default/files/microsites/ostp/STEM-ED_FY15_Final.pdf



1st Annual DimensionU Department of Defense Tournament

Over 22% of AFRL/RI's Scientists and Engineers are involved in STEM Education

Local area math scores in grades 3-8 increased in proficiency level by 6.5% from 2013 to 2014, compared to a 4.6% increase across New York State, per the NY State Education Department



Engineering Camp

Improve STEM Instruction

Teacher Training Workshops:

Teachers are trained in educational areas outside the standard curriculum.

Cornell Cooperative Extension of Oneida County resources:

STEM projects are frequently run by AFRL/RI researchers.

Staying Safe On line Workshop:

Parents and students gain insight into how to stay safe while enjoying the benefits provided by the internet.

Robotics in School Program:

Teachers and mentors are trained in a nationally competitive program geared toward elementary and middle school students.

Dimension U:

Nationally competitive math program offered to elementary and middle school students that utilizes their interests in video gaming to increase math skills.

Increase and Sustain Youth and Public Engagement in STEM

Challenge Competition:

High school competition that addresses real world problems defined by senior AFRL/RI researchers. Students compete for paid summer internships at AFRL/RI and local companies.

Robotics Camp:

Exposes middle school students to problem based learning through projects that concentrate on programming and controlling robots.

Cyber Summer Camp 1.0 & 2.0:

One-of-a-kind program for students in grades 7-10, where Cyber experts from AFRL/RI, industry and local enforcement agencies deliver sessions.

Lab Tours:

Students are exposed to various AFRL/RI technologies, including the Condor Cluster PlayStation Farm, Anechoic Chamber, and Visualization technology.

Cyber Patriot Competition:

A national high school cyber defense competition where students gain cross functional team building skills in a hands-on environment learning about malware, worms, viruses and malicious coding.

March Math Madness Competition:

One-of-a-kind competition which involves teams of students from targeted grade levels.

Career and Science Fairs:

AFRL/RI researchers provide information about AFRL/RI careers and educational background requirements to middle and high school students.

High School and College Internship Program:

Top students gain experience in technical fields.

Engineering Camp:

Students learn about simple machines, Archimedes' Principle, Newton's Laws of Motion, basic electronics, and DC hobby motors.





Staley Upper Elementary School – Rome, NY
First Annual Department of Defense Math Games
Virtual Tournament First Place – 6th grade division
Second Place – mixed grade division (6-8 grade)

The Opponents:

- *Picatinny Arsenal, NJ*
- *U.S. Army Corps of Engineers, MD*
- *Space and Naval Warfare Systems Command, SC*
- *U.S. Army Corps of Engineers, IL*
- *U.S. Army Research, Development and Engineering Command, AL*



2014 Federal Laboratory Consortium for Technology Transfer National STEM Award

AFRL/RI competed against approximately 300 federal laboratories nationwide and won the STEM award for their work in support of science, technology, engineering and mathematics education.

Information Assurance Cyber Engineering (iACE) Internship



Leadership Development

- Problem solving
- Leadership principles
- Staff rides and tours
- Command styles
- Crisis decision making

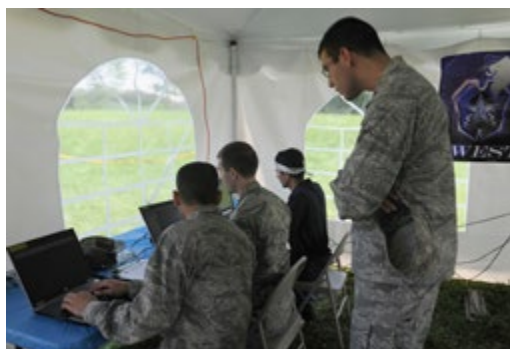
No Excuses • No Extensions • No Exceptions



During the 10 week summer internship, students collaborate with AFRL/RI scientists and engineers to conduct research and development on assuring Air Force mission-critical functions in contested cyber environments.

To qualify for iACE, students must be a rising junior or senior in computer engineering, computer science, electrical engineering, physics, or math, have a minimum cumulative GPA of 3.5, be a U.S. citizen, and qualify for a security clearance. The 2014 class of 41 students included civilians and Air Force/Army/Navy cadets from around the country, as well as British Royal Air Force, Royal Navy, Royal Signal Corp officers and Ministry of Defence civilians.

iACE fosters greater joint and international cooperation among cyber leaders in the future. It is the only pre-commission development course for cyber in the Air Force. The program has been running for over a decade and its over 300 graduates are now entering cyber leadership positions in the Air Force, U.S. Federal Government, industry, and academia.



Capstone

The culmination of 2014's iACE internship was a two-day long capstone event. The capstone exercise represented one of the first cyber exercises to utilize hardware in the loop unmanned aerial systems. Stress data was gathered by instrumenting voluntary participants with a chest strap to measure their heart rate, skin temperature and breathing rate. Participants also completed periodic subjective workload ratings and provided feedback in exit interviews.

Distinguished Visitors

in Fiscal Year 2014



Secretary of the Air Force, Honorable Deborah Lee James



Under Secretary of the Air Force
Mr. Eric Fanning



Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance (AF/A2) Lieutenant General Robert Otto (second from right)



Air Force Materiel Command (AFMC) Commander
General Janet Wolfenbarger



Air Force Research Laboratory Commander
Major General Thomas Masiello



Air Combat Command (ACC) Commander
General Michael Hostage



Air Force Life Cycle Management Center
(AFLCMC) Chief Technology Officer, Dr. Tim Rudolph



Congressman Richard Hanna



Air Force Chief Scientist, Dr. Mica Endsley



Griffiss
Business and
Technology
Park



Total Annual Economic Impact Estimate

Annual
Payroll

Annual
Expenditures

Estimated
Dollar Value
of Indirect
Jobs
Created

\$ 290,917,479

The Secretary of the Air Force for Financial Management (SAF/FM) specified the methodology for computing the economic impact of an Air Force military installation. This methodology is consistent with that used by the Office of the Secretary of Defense (OSD) Base Realignment and Closure (BRAC) Commission.

The Metropolitan Statistical Area includes residences of the majority of the employees at an installation. 100% of the military personnel and 97.5% of the civilian personnel and on-site contractors employed at the Information Directorate (AFRL/RI) make their home in the economic impact area of Herkimer, Madison, Oneida, Onondaga, and Oswego counties.

<note> Please refer to the Analysis Methodology, page 70

FY 2014 Information Directorate

PERSONNEL

**TABLE
1**

	Total	Multiplier	Impact Area Total
Appropriated Fund – Military Active Duty	44	100.0%	44
Appropriated Fund – Civilians	687	97.5%	670
On-site Contractors	435	97.5%	424
Total	1,166		1,138

ANNUAL PAYROLL

**TABLE
2**

	Total	Multiplier	Impact Area Total
Appropriated Fund – Military Active Duty	\$ 5,154,529	100.0%	\$ 5,154,529
Appropriated Fund – Civilians	\$ 76,850,050	97.5%	\$ 74,928,799
On-site Contractors	\$ 51,794,802	97.5%	\$ 50,499,932
Total	\$ 133,799,381		\$ 130,583,260

EXPENDITURES WITHIN THE IMPACT AREA

**TABLE
3**

	Annual Expenditures
Facility Modernization/Sustainment	\$ 3,166,735
Service Contracts	\$ 10,794,100
Research and Development	\$ 65,987,539
Materials, Equipment, and Supplies	\$ 18,946,949
Education	\$ 96,859
Travel	\$ 1,788,673
Total	\$ 100,780,855

Economic Impact Analysis

NUMBER & DOLLAR VALUE OF INDIRECT JOBS CREATED

**TABLE
4**

	Impact Area Total	Multiplier	Impact Area Total Indirect Jobs
Appropriated Fund – Military Active Duty	44	0.35	15
Appropriated Fund – Civilians	670	1.21	811
On-site Contractors	424	1.21	513
Total	1,138		1,339

Estimated Number of Indirect Jobs Created	1,339
Average Annual Pay for the Local Community	\$ 44,476
Estimated Annual Dollar Value of Jobs Created	\$ 59,553,364

TOTAL ANNUAL ECONOMIC IMPACT ESTIMATE FY 2014

**TABLE
5**

	Total Impact
Total Annual Payroll (Table 2)	\$ 130,583,260
Total Annual Expenditures (Table 3)	\$ 100,780,855
Estimated Annual Dollar Value of Jobs Created (Table 4)	\$ 59,553,364
Grand Total Annual Economic Impact Estimate for Five-County Impact Area	\$ 290,917,479

The total economic impact increased \$24 million (9%) from FY 2013 to FY 2014. The leading factors in this increase were the Expenditures within the Impact Area. AFRL/RI continued to invest in laboratory expansions and R&D infrastructure.

AFRL/RI changed its expenditure valuation methods in FY 2014: (1) Current year contract obligations were used vice previous years' method of annualized contract face value awarded and (2) The scope of Facility Modernization/ Sustainment, Service Contracts, and Materials, Equipment and Supplies was expanded in FY 2014 to include both technical expenditures in the local economic area as well as support expenditures (which was used in previous years). The directorate adopted these methods to more accurately report expenditure profiles.

Tables 1 - 5: Please refer to page 70 for Analysis Methodology

Analysis Methodology

The Secretary of the Air Force for Financial Management (SAF/FM) specified the methodology for compiling the economic impact of an Air Force installation. This methodology is consistent with the methodology of the Office of the Secretary of Defense (OSD) Base Realignment and Closure (BRAC) commission. The economic impact area of the Information Directorate consists of the counties of Herkimer, Madison, Oneida, Onondaga, and Oswego.

<https://www.my.af.mil/gcssaf/USAF/ep/contentView.do?contentType=EDITORIAL&contentId=c6925EC16CA3D0FB5E044080020E329A9&print=true> and AFMAN 65-506, Economic Analysis, Chapter 4: Economic Impact Analysis

Table 1: Personnel

The source of the total appropriated personnel was WEB EIS, 30Sep14. The source of the on-site contractors was the AFRL/RI Comm-Computers System, 30Sep14.

Table 2: Annual Payroll

The total annual payroll is a summation of total gross wages, payroll taxes and fringe benefits, derived from AFRL/RIFB at 30Sep14. The payroll for on-site contractors was calculated using an average contractor cost derived from various AFRL/RI contracts.

Table 3: Expenditures Within the Impact Area

Service Contracts include only contracts in the economic impact area or contracts requiring the use of locally supplied goods and services. Research and Development contracts include only those contracts granted to contractors in the economic impact area for scientific and technical work not elsewhere accounted for. Education includes the cost of registered classes and mileage reimbursement for educational institutes located in the 5 county metropolitan statistical area. Travel consists of travel expenditures for military and civilian personnel on temporary duty at AFRL/RI. Source of the Table 3 expenditure data: AFRL/RIFB for Facility Modernization/Sustainment, Service Contracts and Materials, Equipment and Supplies, WEB EIS for Research and Development contracts, AFRL/RIOF for travel, and AFRL/RIOW for education.

Table 4: Number and Dollar Value of Indirect Jobs Created

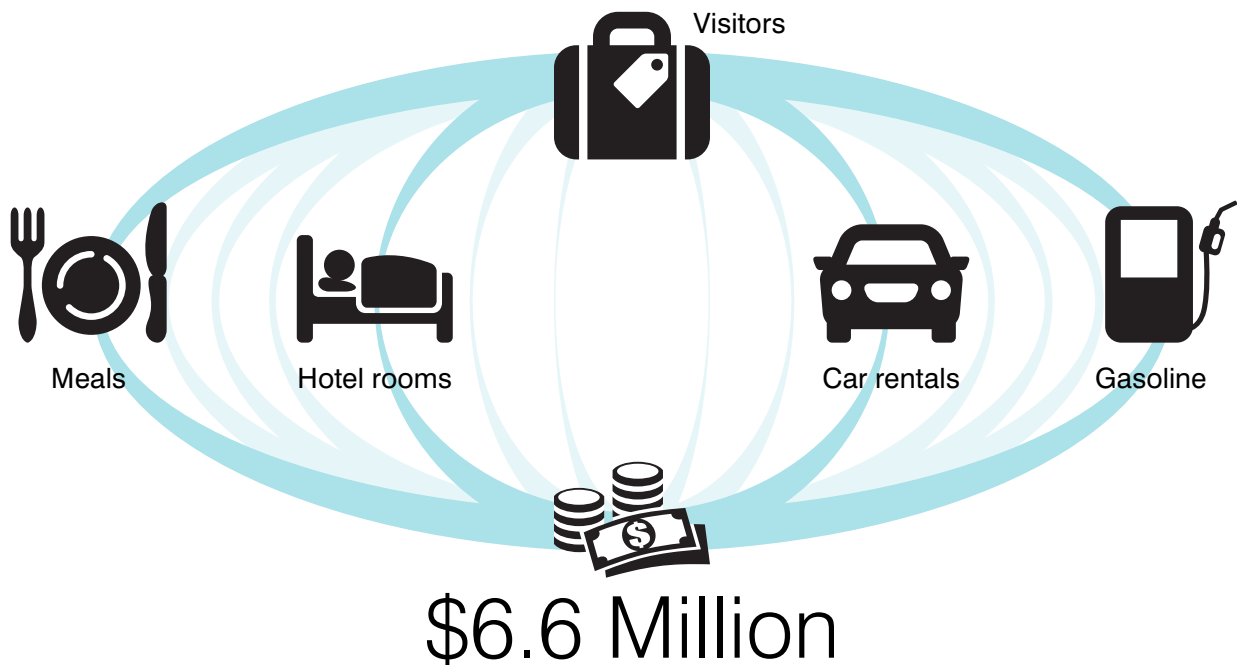
The source of the multipliers in this table is the Economic Impact Database owned by the Logistics Management Institute. The source of average annual pay for the local community is Table 1: Average Annual Wages for all Covered Workers by Metropolitan Area, Bureau of Labor and Statistics (<http://www.bls.gov/cew/home.htm>).

Table 5: Total Annual Economic Impact Estimate FY 2014

This table is the product of Table 2, Total Annual Payroll; Table 3, Total Annual Expenditures; and Table 4, Estimated Annual Dollar Value of Jobs Created.

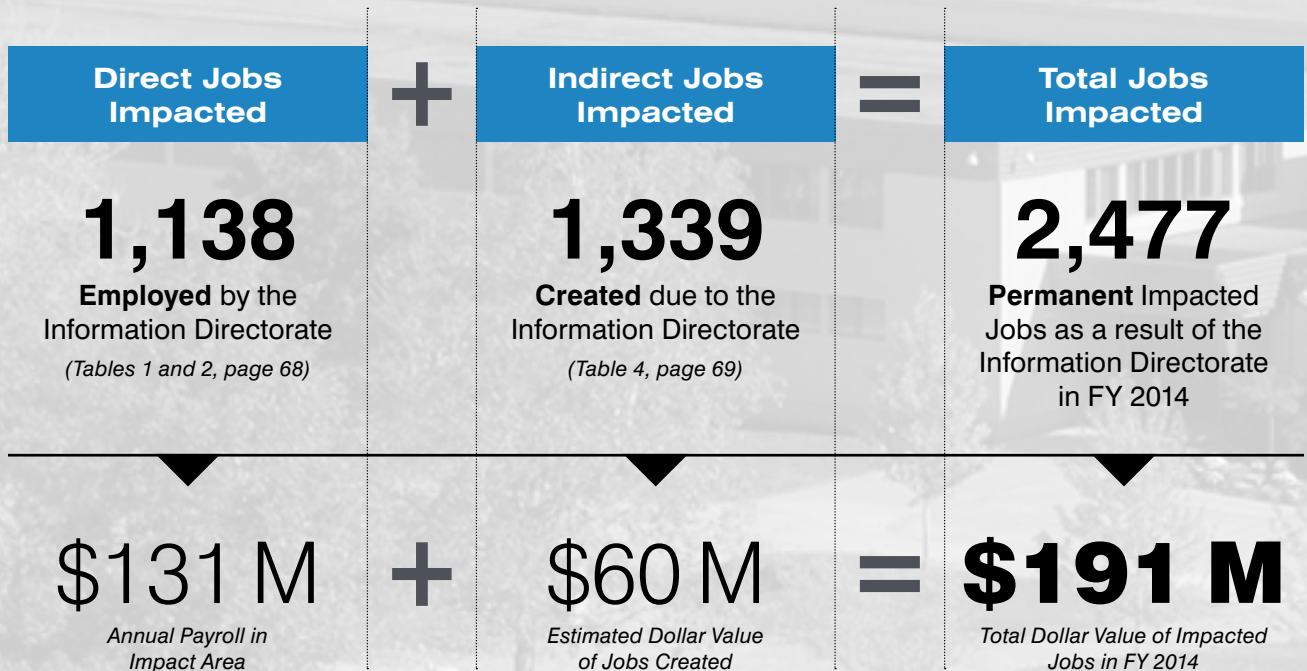


The Economic Impact of Visitors to the Information Directorate



Total economic impact of visitors fiscal years 2010 - 2014

Total Jobs Impacted Within the 5 County Impact Area



The Information Directorate is proud of the strength of its commitment to the local area. The economic impact of the Information Directorate on the 5 county metropolitan statistical area is largely viewed by members of the community in terms of jobs.

In FY 2014, the number of jobs both directly and indirectly linked to the research laboratory was 2,477. The jobs directly associated with the Information Directorate command above average salaries and significant benefits, thus creating the greatest values for the local economy. The indirect jobs are the response by the local economy to the direct jobs. They occur through the re-spending of income received. The income is recirculated through households causing further economic activity. The indirect jobs are created in the areas of services, medical care, police and fire protection, merchandise stores, etc. Associated revenues from sales tax, property tax and income tax also stimulate the local economy.

The Tertiary Impact

The cascading effect of the Information Directorate's presence in the local community reached new and exciting levels in FY 2014.

The lab has always been the local area's high technology economic engine. It acts as a marketing advantage in that it attracts high technology counterparts to locate here. International businesses, large and small companies, academia and nonprofit companies make up the local portfolio. Every year more companies physically emerge on the local horizon, opening their doors to work directly with the Information Directorate and others.

Additional high technology investments are now beginning to take root in the metropolitan statistical area and the magnitude of such investments are increasing. Local community groups, municipalities, industry and academia have all been involved in initiatives that will improve our high tech stronghold.

Attracting innovative knowledge-based businesses and talented young professionals enhances the local image. The community benefits from the higher levels of educational attainment, workforce success and progressive strategy for long term stability.

SUNY Polytechnic Institute, Quad-C Facility, at Marcy Campus

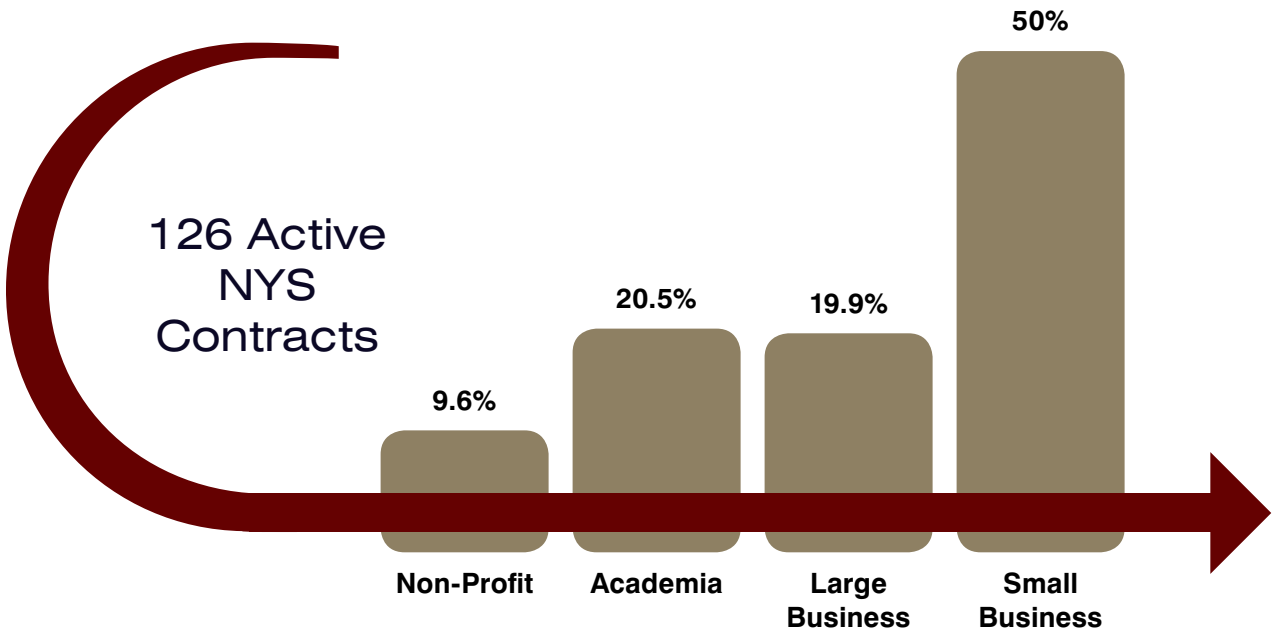


Local investments:

- Northeast UAS Airspace Integration Research Alliance (NUAIR)
- Marcy Nanocenter
- SUNY Polytechnic Institute

AFRL/RI:
A proponent of
High Tech Progress

New York State Contracts



The Total Contract Face Value of
126 Active New York State Contracts is

\$246,571,795

Top Ten New York State Contractors in FY 2014 Obligated Dollars

- Assured Information Security*
- Black River Systems Company, Inc.*
- Cornell University
- Exception Technologies, LLC
- Kitware, Inc.
- North Point Defense, Inc.
- Research Foundation of The State University of New York
- Rome Research Corporation
- SRC Inc. (formerly Syracuse Research Corp.)
- The Trustees of Columbia University

**Denotes Small Business*

Harnessing the Power of New York State Based Collaboration



Based in New York State:

- 16 Cooperative Research & Development Agreements (CRADAs) with AFRL/RI
- 54 Educational Partnership Agreements (EPAs) with AFRL/RI
- 21 Visiting Professors came from New York educational institutions

FY 2014 Academic Affiliations

The Information Directorate has a long history of academic collaborations. The scope is governed by the lab's mission-based needs, making it well situated to leverage the enormous potential offered by the research and educational institutions.

Long-term partnerships with educational institutions, via contracts, grants and cooperative agreements have always been integral in strengthening the directorate's ability to deliver world-class research. The short-term partnerships such as educational partnership agreements (EPAs) and cooperative research and development agreements (CRADAs) are also mechanisms that provide joint and collaborative research. They offer opportunities to transfer and/or enhance technology applications and provide technology assistance for all levels of education (pre-kindergarten through graduate students).

The benefits of academic collaboration are multi-faceted. Not only is the research and technology leveraged, but also the scientist and engineer talent base continues to grow and remain cutting edge.



130 Contracts, Grants and Cooperative Agreements
with FY 2014 obligated dollars

86 Educational Partnership Agreements (EPAs)

34 Science, Technology, Engineering and Math (STEM) EPAs

23 Basic Research/Equipment Donation EPAs


3 Academic Cooperative Research & Development
Agreements (CRADAs)

Summer Hosts to Academia

Summer is an exciting season at AFRL/RI, as the lab plays host to visiting professors, undergraduate and graduate students as well as high school students. Many travel from out of state to work side-by-side with the Information Directorate scientists and engineers. This unique opportunity for academia and the Air Force to work together advances the state of the art in information technology for the Air Force, DoD, and industry.

Undergraduate & Graduate Students

108






High School Students

12

Time Period






Universities Represented

85

Number of States Represented

Thirty Two



Alabama, Arkansas, Arizona, California, Colorado, Florida, Idaho, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Minnesota, North Carolina, North Dakota, Nebraska, Nevada, New Jersey, New York, New Mexico, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Wisconsin, Virginia

The History of Rome Research Site

1917 U.S. Army Signal Corps established a Radio Laboratory at Ft. Monmouth, NJ. Watson laboratories became an offshoot of the original Radio Laboratory.

1942 Griffiss Air Force Base was completed in Rome, NY. Its main purpose was to store, maintain and ship equipment for the Army Air Corps.

1950 Congress passed an act authorizing the establishment of the Air Force Electronic Development Center at Griffiss Air Force Base. President Harry S. Truman directed the transfer of personnel from Watson Laboratories to Rome, NY.



— **1951** Rome Air Development Center (RADC) was established to research and develop ground electronics for the Air Force.



— **1990** The Air Force realigned 14 laboratories into 4 “super” laboratories, one of which was Rome Laboratory, which evolved from RADC.



— **1995** The Base Realignment and Closure (BRAC) Commission closed Griffiss Air Force Base but maintained Rome Laboratory as a “stand alone” facility.



— **1997** The Air Force consolidated its laboratories into the Air Force Research Laboratory (AFRL), headquarters at Wright Patterson AFB, OH under the Air Force Materiel Command. Rome Laboratory became AFRL's Information Directorate.



— **2005** The Base Realignment and Closure (BRAC) Commission provided the means to enhance AFRL's mission effectiveness as it consolidated its technical directorates. AFRL/RI consolidated at Rome, NY.

The Early Legacy of Rome, NY



1758

Fort Stanwix was built during the French and Indian War. American leaders recognized the importance of its location and it was then used in the Revolutionary War. In the August 1777 siege, it became known as “the fort that never surrendered”. During this time, a striped, red, white and blue flag was flown “on behalf of these United States”. Some say this was the first time the American flag was flown in battle.



1777

The Battle of Oriskany was one of the bloodiest battles of the Revolutionary War. The retreat of General St. Leger prevented the British from taking New York, which led to their surrender at Saratoga and ended the British invasion of the Northeast.



1817

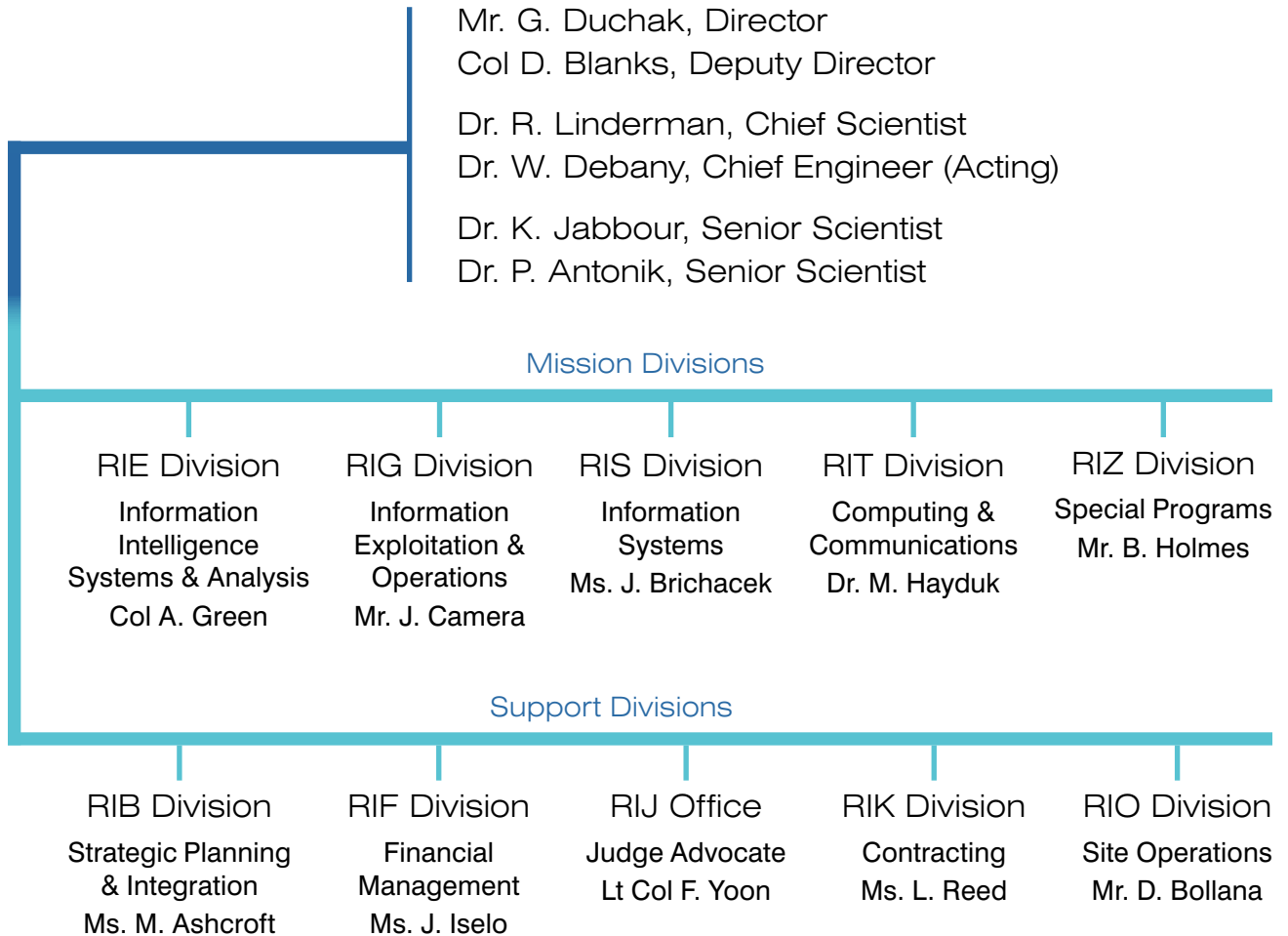
The Erie Canal started construction in Rome, NY. It became the most famous and successful of America’s early towpath canals, connecting the Northeast to mid-America.



1892

Rome native, Francis Bellamy wrote the Pledge of Allegiance. He is buried in the family plot in Rome, NY.

Information Directorate (AFRL/RI) FY 2014 Organization Chart



FY 2014 Collaborators

Joint Community

CENTCOM – U.S. Central Command
NORTHCOM – U.S. Northern Command
PACOM – U.S. Pacific Command
SOUTHCOM – U.S. Southern Command
STRATCOM – U.S. Strategic Command
TRANSCOM – U.S. Transportation Command

Services

Army
Navy
Marines

United States Air Force

ACC – Air Combat Command
AFGSC – Air Force Global Strike Command
AFMC – Air Force Materiel Command
AFSOC – Air Force Special Operations Command
AFSPC – Air Force Space Command
AMC – Air Mobility Command
ANG – Air National Guard
PACAF – Pacific Air Forces
USAFE – United States Air Forces in Europe

Intelligence Community

CIA – Central Intelligence Agency
DIA – Defense Intelligence Agency
IARPA – Intelligence Advanced Research Projects Activity
NASIC – National Air and Space Intelligence Center
NGA – National Geospatial-Intelligence Agency
NRO – National Reconnaissance Office
NSA – National Security Agency

International

Australia
Canada
Czech Republic
Singapore
United Kingdom
AOARD – Asian Office of Aerospace Research and Development
EOARD – European Office of Aerospace Research and Development
NATO – North Atlantic Treaty Organization
TTCP – The Technical Cooperation Program

Other Department of Defense Agencies

DARPA – Defense Advanced Research Projects Agency
DTRA – Defense Threat Reduction Agency
MDA – Missile Defense Agency

Other Agencies

DHS – Department of Homeland Security
DOE Labs – Department of Energy Labs
FAA – Federal Aviation Administration
FBI – Federal Bureau of Investigation
MITRE Corporation
NASA – National Aeronautics and Space Administration
NIST – National Institute of Standards and Technology

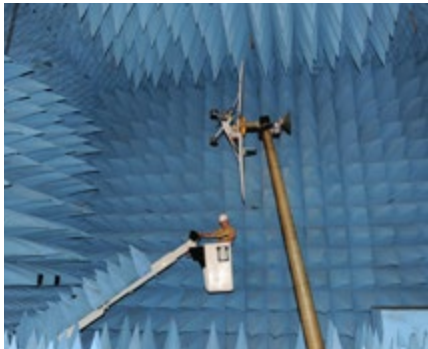
Industry (Top 10)

Assured Information Security, Inc.
BAE Systems Information Solutions
Exelis, Inc.
Intelligent Software Solutions, Inc.
Lockheed Martin
Northrop Grumman
Raytheon BBN Technologies Corp.
Rockwell Collins, Inc.
SRI International
TT Government Solutions, Inc.

Academia (Top 10)

Carnegie Mellon University
Columbia University
Cornell University
Leland Stanford Junior University
Massachusetts Institute of Technology
Regents of the University of California
The Research Foundation of the State University of New York
University of Illinois
University of Pennsylvania
University of Washington

2014 Information Directorate Facilities



Radio Frequency (RF) Technology Center



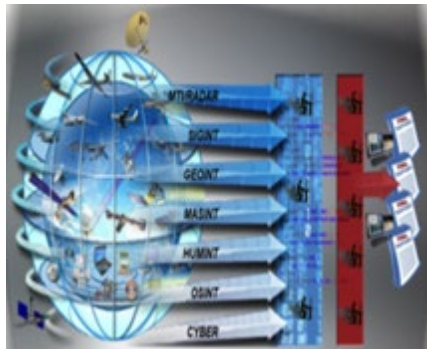
Quantum Information Science Laboratory



Nanocomputing & Computational Intelligence Laboratory



Advanced Visualization & Interactive Displays (AVID)



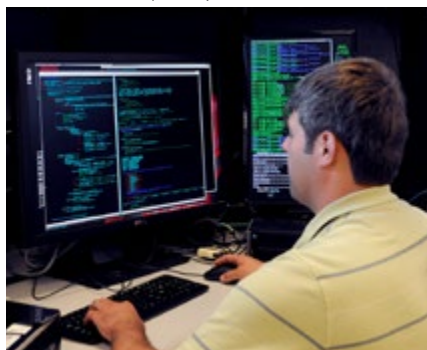
Advanced Processing and Exploitation (APEX) Center



Situation Awareness Laboratory



Advanced Computing Applications Laboratory



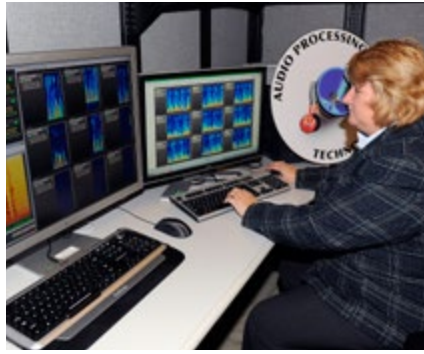
Cyber Integration and Test Environment (CITE)



Command & Control Concept Center (C2CC)



Command and Control Technology Center (C2TC)



Audio Processing Laboratory



High Performance Computing Facility



SATCOM Facility



Quantum Communications Laboratory



Network-Centric Integration & Interoperability Facility (NCIIF)



Stockbridge Research Facility



Operational Information Management Development Laboratory



Integrated Intelligence Innovation Facility (I3F)



Black Room



Newport Research Facility

Information Technology Heritage

1947 – Air Force established

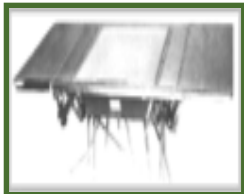
1948 – Watson Labs (NJ) personnel arrive at Rome Air Depot to establish Electronics R&D center

1951 – Rome Air Development Center established

1951 – AN/FPS-6
1st long-range height finder radar for SAGE



1951 – Film viewing table



1951 – AN/FRN-12 VOR



1951 – AN/GRC-27
Ground-to-air radio

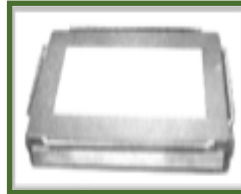


1951 – AN/CPN-4
Ground controlled approach radar

1953 – AN/GPA-23
analog computer



1953 – Portable IR detector



1955 – White Alice - Troposcatter DEW line extension



1955 – AN/FPS-17
Space Surveillance Radar, 1st to detect objects in space



1956 – AN/GSN-5

1956 – Minicard intelligence data handling system

1957 – AN/FRC-53/54
Tropo scatter radio

1957 – All-transistor digital computer

1958 – AN/FSQ-27
Polymorphic Data Processing Center



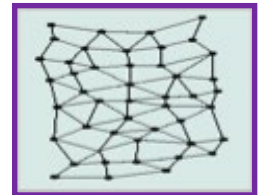
1958 – Roll film stereoscope



1958 – BMEWS prototype at Trinidad



1959 – 1st packet switching network



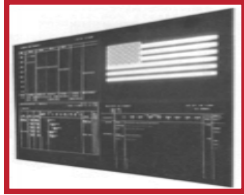
1959 – TROPICAN - IR detection of enemy campfires in Puerto Rico



1950s

1960 – AN/TLQ-8 passive jammer locator

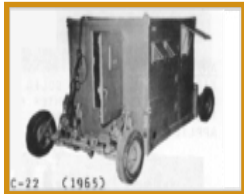
1960 – 456L Quadrajector display system for SAC



1960 – Echo I – 1st human voice from space



1961 – AN/FCC-17 Multiplexer

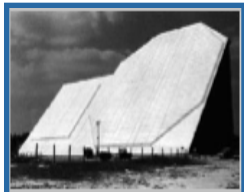


1961 – Image interpretation shelter



1962 – 1st fiber optic switch for computer systems

1962 – AN/FPS-85 1st phased array radar to track objects in space



1963 – Back-Up Intercept Control System – would later replace SAGE air defense system



1963 – BR-90 Visual Analysis Console



1963 – CHICODER



1964 – Solomon Parallel Computer

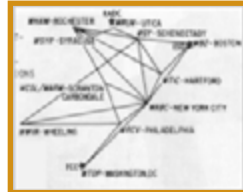


1964 – Mark II Russian Language Translator



1965 – Billion bit memory

1965 – Multi-frequency survivable network



1965 – AN/FPS-92 Tracking radar for Site II BMEWS



1966 – 1st full color laser display



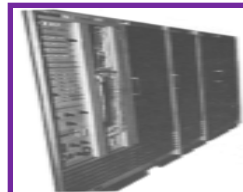
1967 – AN/PRC-72 Multimode manpack radio



1967 – AN/USA-26 Tactical modular display



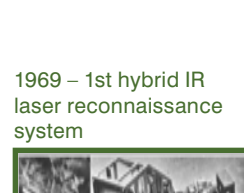
1968 – Largest content-addressable memory capacity in US



1968 – One of 1st nodes on ARPANET



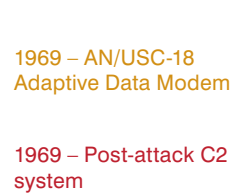
1968 – IDHS deployed to 7th AF in SE Asia



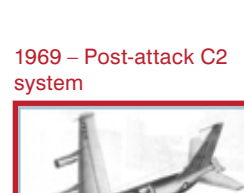
1969 – 1st hybrid IR laser reconnaissance system



1969 – AN/GSC-25 Ultra high-speed data modem (14.4 kbps)



1969 – AN/USC-18 Adaptive Data Modem



1969 – Post-attack C2 system



Command and Control

Communication

Computing

Intelligence/Reconnaissance

Surveillance

1960s

1970 – OTH Radar



1970 – Tactical Situation Display



1970 – Dynamic Real-Time Information Projection System (DRIPS)

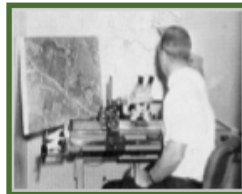


1970 – TACSAT-1

1970 – PACER - for SAC Intelligence data handling



1971 – Side-looking radar



1972 – AN/UYA-10 Mass RAM

1972 – COBRA DANE



1972 – Antenna measurement facility



1973 – AWACS technology



1974 – Advanced airborne command post



1974 – AN/USC-26 Group Data Modem (153.6 kbps)



1974 – VP-8 Image Analyzer



1975 – PAVE PAWS



1976 – Cambridge (MA) Research Labs restructured into RADC

1976 – Space-Based Radar



1976 – AMOS transferred to RADC

1976 – PDSC - PACOM Data Systems Center

1977 – Fiber Optics secure communication system

1977 – AN/FPS-117 SEEK IGLOO



1978 – AIREAS Advanced imagery requirements & exploitation system

1978 – SPEAK EASY secure voice digital comm system

1978 – COBRA JUDY



1978 Communications support processor – DoD fixed base telecom automated message handling

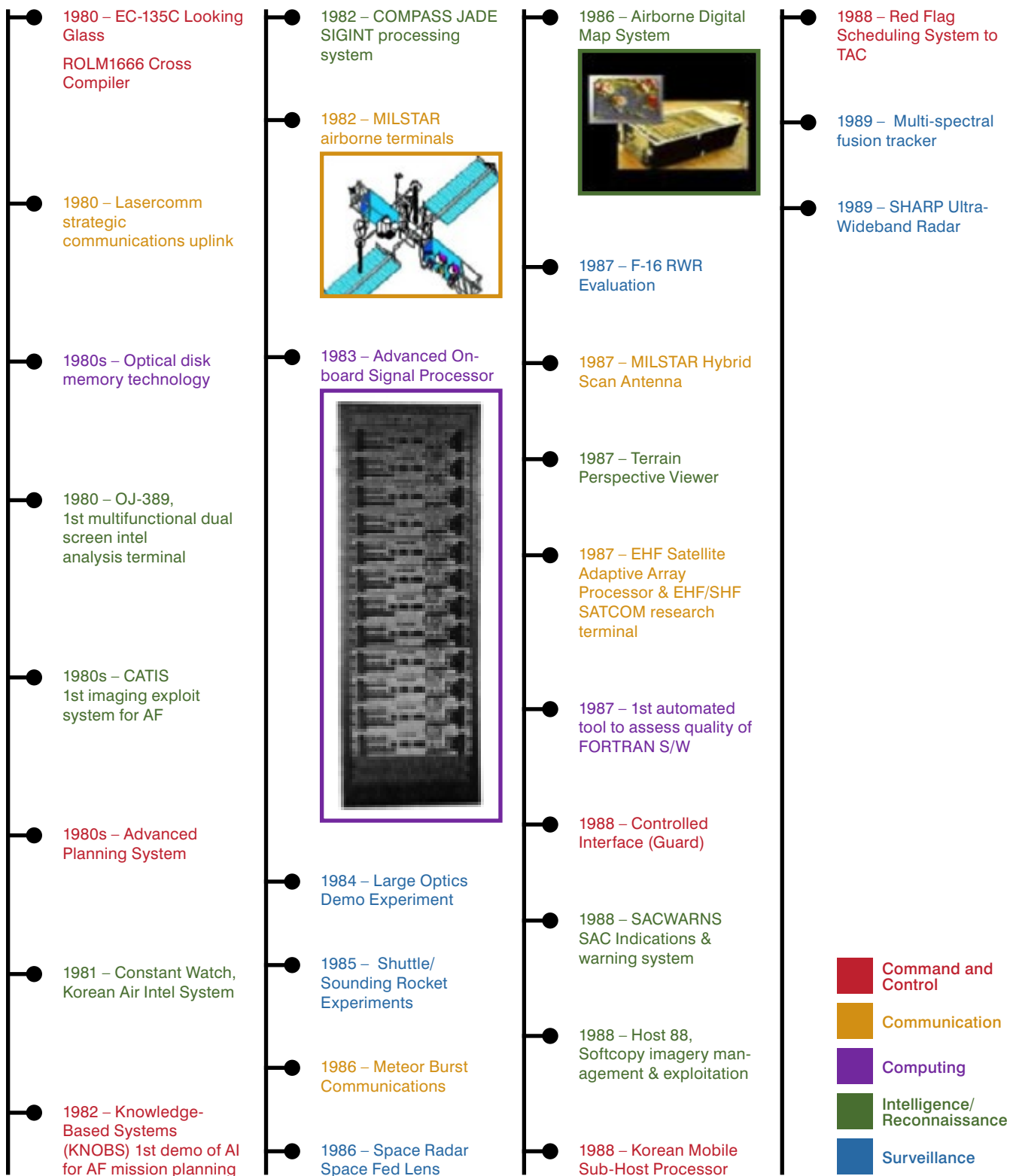
1979 – Micro Programmable Controller

1979 – PAVE MOVER



"By late 1970s ... the AF's 'center of excellence' for C3I" (T.W. Thompson, 1991)

1970s

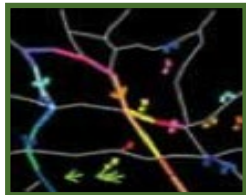


1980s



1990s

2000 – MTIX – 1st Moving Target Indication exploitation tool for JSTARS



2000 – STAP with Sum & Difference Channels

2000 – JPD 2.0 Fielded in TBMCS, 1st 3-tiered app in AOC

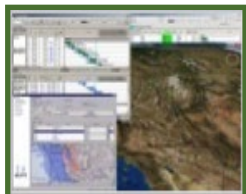
2001 – WebTAS



2001 – ISSE Guard in AOC

2003 – Sensors as Robots Concept

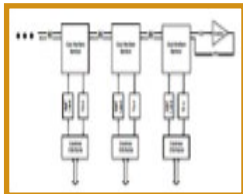
2003 – Master air attack planning toolkit



2003 – Integrated Information Management System (IIMS)



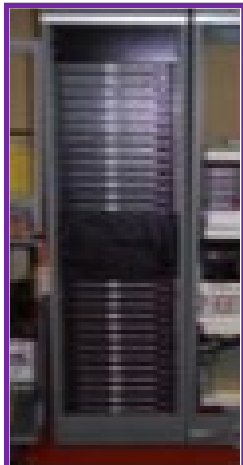
2003 – Highly Integrated Photonics (Later used in JSF)



2004 – JSF



2004 – Dual Xeon cluster 530 GF, 7 KW (76)



2005 – Ultra-Narrowband Adaptive Tomographic X-Band Radar

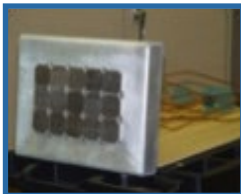
2005 BRAC

2005 – Atlantis, 1st web-based MTI server capability

2006 – Swathbuckler 24-node Dual Xeon Cluster



2006 – Range-dependent Frequency Diverse Array



2007 – Joint Capability for Airborne Networking (JCAN)



2007 – Cyclops Cell-BE Architecture

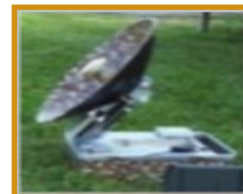


2007 – Distributed & Layered Sensing Concept

2007 – Rome Audio Processing Toolkit (RAPTR)



2008 – Man-portable X-Band SATCOM



2008 – Cell cluster - 53 TF, 35 KW (1510)



2009 – Adaptive Polarization Processing for Detection of Thin Wires

2009 – Global Response & Synchronization/ Work-Centered Interface Distributed Environment



2009 – TTNT Phase 3



Command and Control

Communication

Computing

Intelligence/Reconnaissance

Surveillance

2000s

2010 – Marti Information Management System

2010 – VideoSAR General Purpose Graphical Processing Unit Architecture



2010 – Battlefield Airman Targeting Network (BATNET) for BAO Kit



2010 – DoD's largest interactive super-computer

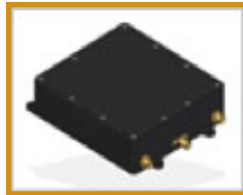


2011 – AN/TRC-215 Remote radio

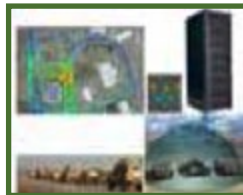


2011 – SIRIS - A web based SA capability for RPA pilots

2011 – Mini-CDL



2011 – CREW PED



2011 – Detection of IEDs Using Target Resonances

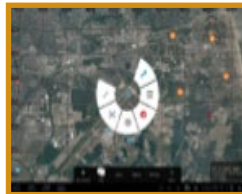
2011 – Combined Info Data Network Exchange (CIDNE)



2011 – JWIN JCTD Integrated tactical netops Situational Awareness for JFC



2012 – Android Tactical Assault Kit



2013 – Cyber Scoti



2013 – Secure View



2013 – Cyber Trusted Router

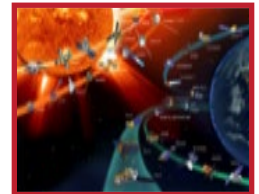


2013 – PCPAD-X

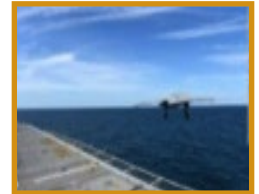
2013 – OpenPod



2013 – AFRL/NRO Space Planning

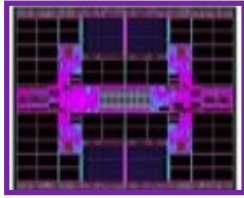


2013 – X-47B UCAS launched from carrier using TTNT Phase 3



2010s

2014 – Cyber Secure Processor



2014 – Spider Sense



2014 – SIGINT Tactical & Analysis Reporting Gateway (STARGate)



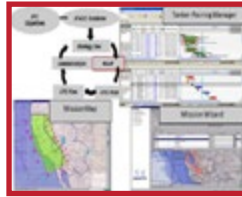
2014 – Text Analysis



2014 – Collaboration Gateway: TransVerse Chat Client



2014 – Master Air Attack Planning Toolkit (MAAPTK)



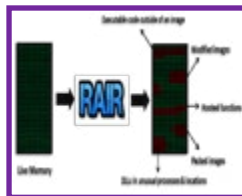
2014 – Semantic Auto Tagging & Routing



2014 – Integrated Information Management System (IIMS) Increment 2



2014 – Real-time Analysis for Incident Response (RAIR)



2014 – Alert-to-Share



2014 – Knowledge Association SIGINT Toolkit (KAST) Watchdog



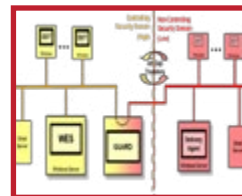
2014 – Titan - Threat Intelligence Platform



2014 – Exploitation of Audio



2014 – Security and Workflow Enforcement Services (SAWES) v3.3



2014 – Multi-Level Data Base Replication (MLDBR) v3.2



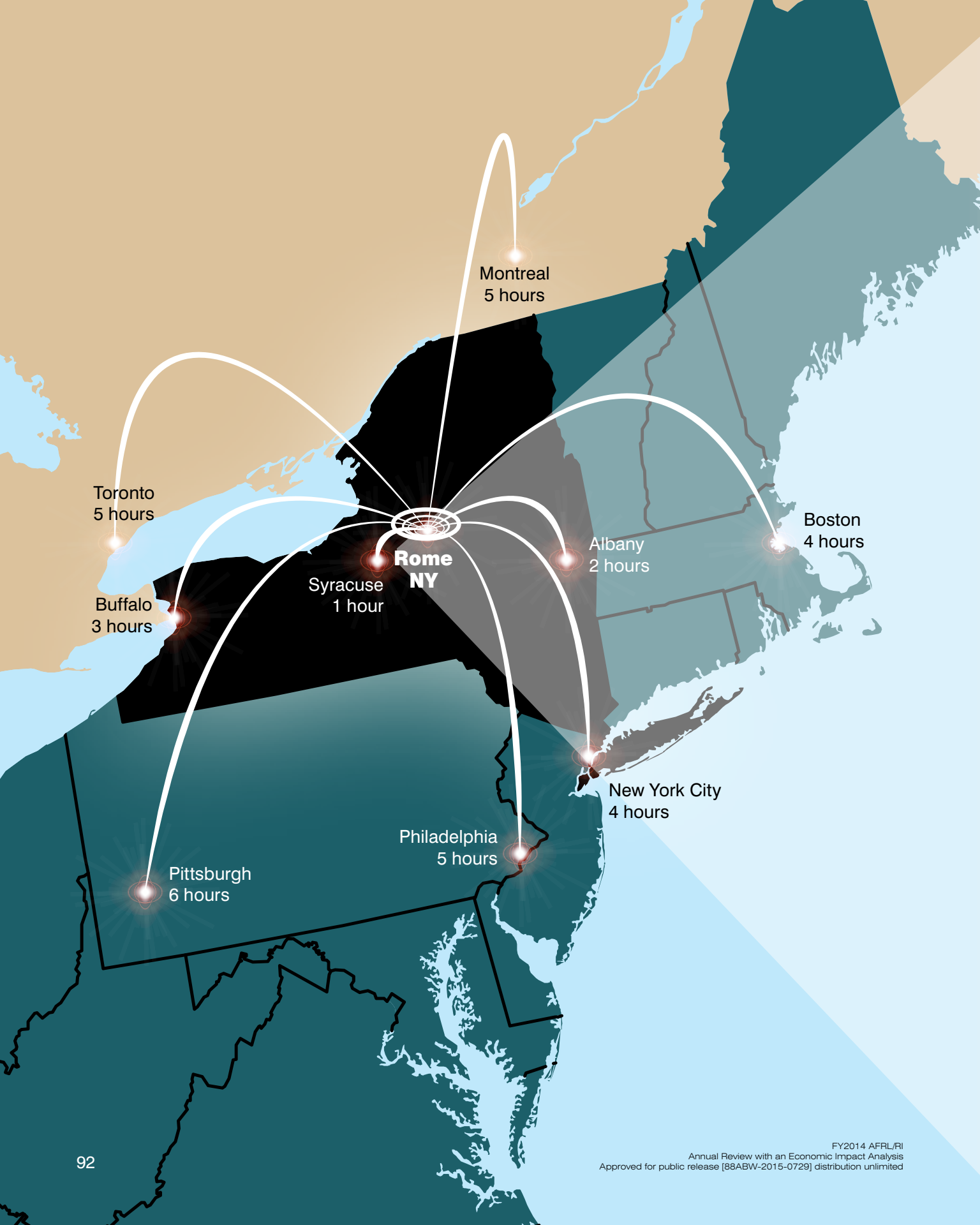
2014 – Metaspense



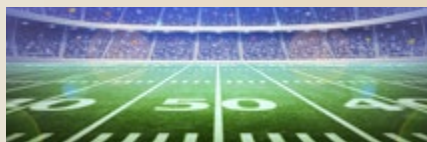
2014 – Information Support Server Environment (ISSE) v4.1



2010s



Central NY Attractions



Notes page

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United States Air Force

Our three core values:

**Integrity First
Service Before Self
Excellence In All We Do**



The Core Values are much more than minimum standards. They remind us what it takes to get the mission done. They inspire us to do our very best at all times. They are the common bond among all comrades in arms, and they are the glue that unifies the Force and ties us to the great warriors and public servants of the past.

– Airforce.com



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